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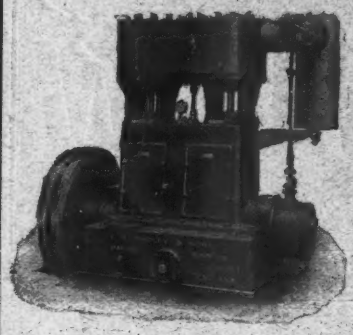

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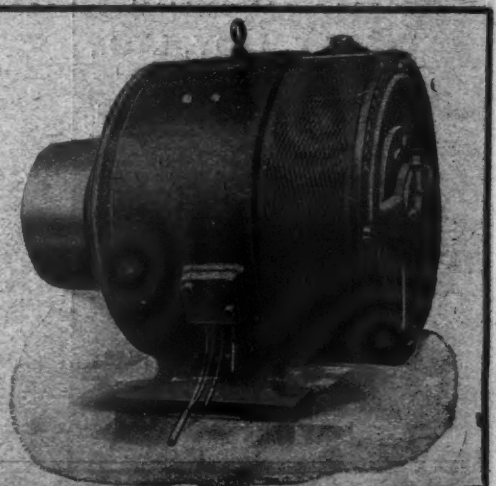

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FUEL ECONOMY.

IN the course of an interesting, if somewhat speculative, address by Prof. Arnold Lupton to the South Wales Institute of Engineers, last year, the author estimated that, despite the enormous output of coal from the mines of the United Kingdom during the past century, we still possess no less than 97 per cent. of our original endowment, and that even after making due allowance for an increase in the annual tonnage raised in this country to a value approaching 400 million tons per annum, there is enough coal in our reserves to last for nearly 1,000 years. By that time, it is to be hoped, substitutes for coal will have been found; possibly the key to the stores of energy locked up in matter will have been discovered—Prof. Soddy in 1906 assured us that in a single ton of uranium, costing less than £1,000, there was more energy than would be supplied by all the electricity works in London working for one year, and Sir Oliver Lodge, in 1907, stated that the intrinsic energy of motion in a cubic millimetre of ether was equivalent to 1,000,000 H.P. working for 40,000,000 years—so that posterity need not be exercised in mind over the problem. Prof. Arnold Lupton also outlined other sources of energy that might—we do not say could—be utilised, such as the sun-power of the Sahara Desert, of which 10 million KW. might be transmitted to this country through an iron cable of 5,000 sq. in. cross-section at 100,000 volts, at a cost of 0.36d. per KW.-hour. for transmission, and a total cost of 0.727d. Clearly he is a man of large and optimistic, if chimerical, ideas. Unfortunately, however, we live in the present, and must make the best of the conditions under which we exist, and, even if the conservation of our fuel be of no account on the score of its duration, we must still put forth every possible effort to reduce the consumption of coal, and to utilise it to greater advantage, simply in order to economise labour and capital—in the coal mines, on the railways, and elsewhere—to enable our industries to compete effectively with our foreign rivals, and to improve the conditions of existence throughout this realm.

We turn, therefore, with pleasure to the excellent series of Howard Lectures delivered by Prof. J. S. S. Brame last November, and published in the *Journal* of the Royal Society of Arts last month. The author points out that our improvident use of coal in the past has been due largely to its cheapness. This is a factor which henceforth will be materially modified, for it cannot be anticipated that the price of coal will ever again approach the pre-war level in this country. But our very existence as a great nation depends upon cheapness of manufacture, and hence, if coal is to cost more, we must use less of it. Prof. Brame favours the imposition of a duty on exported coal, with the double object of gradually reducing the quantity exported, and raising funds for the investigation of our fuel resources and the development of methods for their more economical utilisation; an excise duty on exported coal is no new thing, and the policy suggested appears to offer obvious advantages.

It should not be forgotten that great strides have already been made in the direction of economy in

recent years, very largely through the influence of electrical engineers, so far as relates to the generation of power by steam, gas, or oil, and that of gas engineers in connection with the scientific utilisation of coal, with no other spur than that of commercial exigencies—backed, it is true, by the innate craving of every true engineer to get the best out of his plant and materials. The progress achieved is recognised by Prof. Brame, who looks to the continued stimulus of sound commercial enterprise rather than to the artificial aid of legislation to produce further economies in the future, though he approves of Government action in promoting research in this and other directions, and in restricting wasteful methods of coal-getting. As regards the use of exported coal as a means of paying for our imports, an argument which may have some weight during the war, when we are drawing freely on the capital of the Empire in every possible direction, it should not be overlooked that by so doing we voluntarily degrade ourselves to the rank of "hewers of wood and drawers of water" for other nations. British work-people are admittedly capable, when trained, of attaining to the highest standards of skilled handicraft in almost any industry that is practised by white men, and are worthy of a better fate than to be the slaves of foreign craftsmen. What we should aim to export is expert workmanship and brains, not manual labour, and our priceless stores of fuel should be a means to that end, and not the end itself.

Touching upon the methods available for utilising coal to better advantage, the author refers to the growing use of coke for raising steam in boilers, and mentions that at Deptford, during a period of one month, 16 per cent. was saved in fuel costs. The increase in production of ammonium sulphate at coke ovens during recent years is of great promise, and would be greatly assisted by the gasification of coal in producers with recovery plant. The mechanical stoker enables small coal to be utilised to advantage, and affords an outlet for fuel which formerly was looked upon as rubbish, though unfortunately a great deal is still left in the pits. Indeed, the record of deliberate rejection of valuable coal, due to the low prices that have obtained in the past, is painful to contemplate. In this connection we may draw attention to the interesting results which have been obtained with fuel of very low grade in the huge power stations on the Rand, and which are described elsewhere in our pages to-day; under war-time conditions a great many of our power stations at home are operating with coal of equally poor quality.

Whilst he points out that at present, with steam power, we utilise only 10 per cent. of the available energy of coal, and by using gas power the percentage could be doubled, Prof. Brame recognises the superiority of the steam turbine as a prime mover; but he states that the gasification of coal for use under boilers would result in an efficiency of only 55 per cent., as compared with 80 per cent. from coal-fired boilers, and holds that it would not pay to adopt the former practice, owing to the cost of by-product recovery plant. On the other hand, the use of coke for domestic heating in improved grates would result in economy and freedom from the smoke nuisance, and he regards "low-temperature coke" as an almost ideal smokeless fuel. In industrial areas he recognises the enormous economies that can be effected by linking-up power stations, utilising waste heat from blast furnaces, &c., as on the North-East Coast, and thus he is led to advocate unification as the essence of success, though he appears to hold somewhat exaggerated views on the difficulties to be overcome. Finally, the author points out the advantages that could be derived from co-operation between gas and electricity supply undertakings, together with low-temperature carbonising concerns, particularly referring to the Metropolitan area as offering unique opportunities to such a combination.

The same subject was discussed by the Manchester Local Section of the Institution of Electrical Engineers last week, and we cordially hope that the attention which is now being devoted to the matter will bear fruit speedily and in abundance. Nearly five years ago we remarked that the trend of thought among scientists of all professions was: "(1) Burn your fuel economically; (2) Burn it centrally; and (3) Transmit by electricity. Thus the future of our industrial life rests largely with electrical engineers"—and the same holds good to-day.

The B.E.A.M.A. Report.

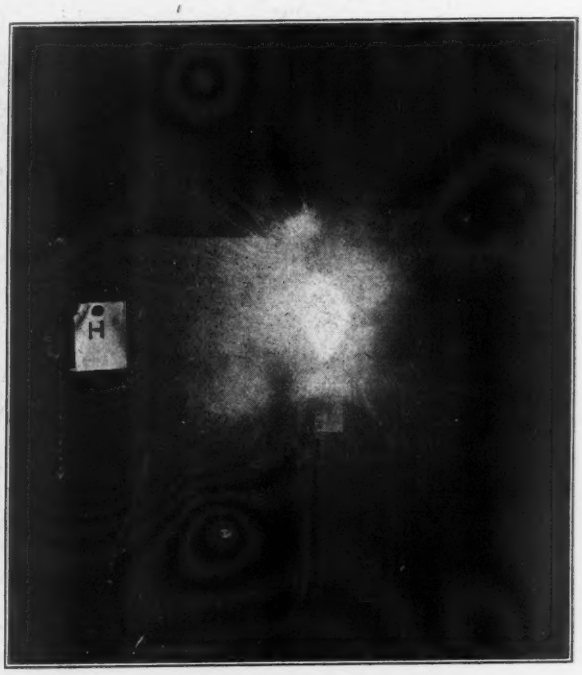
We print in this issue the concluding part of the annual report of the British Electrical and Allied Manufacturers' Association. We believe that it is the first occasion since the outbreak of war on which we have received a copy of the Association's complete report, and we welcome the return to the policy of letting the world at large know as much as can reasonably be told of B.E.A.M.A. activities. The membership of the Association three years ago—before the war—was 125, which represented an increase of 16 firms. But there have been a number of changes due to the war and other causes, and to-day the total is 144, 30 new firms enrolling and one resigning during 1916. We are pleased to note the optimism of the Council in regard to the prospects for regaining export trade which has been temporarily lost owing to overwhelming activities in our factories during the war. We believe that the reasons for that optimism are sound, provided proper measures are taken immediately to keep closely in touch with the Colonial and foreign markets, and to let them know how great is the sacrifice of the British manufacturer to the common cause. The measures of the B.E.A.M.A. in this connection are summarised in our last week's extracts from the report, and they are apparently such as to form a good war-time beginning for a policy of British electrical export trade propaganda which can hardly fail to bring large volumes of business to our industries from all parts of a world stripped of its electrical supplies. Matters of research, standardisation, the call for British equipment for Pekin University laboratories, schemes for the better organisation of all industries, the better education of the public in regard to the indispensability of our engineering industries, and many other matters, have received the attention of the Association's Committees and staff during the year. There have been conferences with Government Committees respecting trade matters and negotiations, highly successful in their issue, concerning excess profits, while the "industrial solicitor" has apparently had a very busy time dealing with questions raised in relation to Model Conditions of Sale and Contract. Altogether, the report forms very healthy reading. The Association is now engaged upon measures for effecting domestic co-ordination, so that the efforts of all the many Sections may be concentrated where desirable in a new Sectional Committee or Board. Uniformity of policy in matters common to all Sections may thus become possible. A removal from the existing premises to larger ones, owing to the growth of the Association, has been considered, but, like many other things, it has had to be left over until after the war.

The Association is to be congratulated upon its record of a year of great activity, attended by success in many ways. The period has been one of great difficulty for normal industry, but the very difficulties of the situation have themselves afforded abundant opportunities for usefulness on the part of the organisation.

FUSE FAILURES.

Mr. S. W. Baynes, chief electrical engineer of the St. Pancras electric supply undertaking, has communicated to the Press the results of a series of interesting tests on fuses of the open type under working conditions.

220-volt Short Circuit on 3-in. Clear Break; 10-ampere Fuse; Two Strands 5-ampere Lead.



220-volt Short Circuit on 4-in. Break; 10-ampere Fuse: Two Strands 5-ampere Lead.

440-volt Short Circuit on 3-in. Break; 10-ampere Fuse; Two Strands 5-ampere Lead.

440-volt Short Circuit on 4-in. Break; 10-ampere Fuse; Two Strands 5-ampere Lead.

The advent of large turbo-generators giving an unlimited rush of power brought to his notice many serious failures of such fuses, and it was therefore decided to experiment, with a view to ascertaining their controlling power; a series of interesting views was obtained, some of which Mr. Baynes has kindly placed at our disposal.

With a view to securing normal working conditions, current was drawn from the St. Pancras distributing system (which is supplied in part from D.C. turbine plant), passing through a long feeder and back to the power station, where the tests were carried out, *viâ* distributing mains.

The mains system in use was as follows:—

Feeder, D.C., 440 volts across outers; 220 volts between neutral and outers; neutral earthed at power station.

Total length of lead and return for:—

440-volt tests—3,460 yards, consisting of 1,730 of 1 sq. in. feeder, 330 of 0·2 sq. in., 1,000 of 0·25 sq. in., 400 of 0·5 sq. in. distributors, excluding length of connecting cable.

220-volt tests—1,730 yards, consisting of 865 of 1 sq. in., 165 of 0·2 sq. in., 500 of 0·25 sq. in., 200 of ·5 sq. in. distributors, excluding length of connecting cable.

The plant on load consisted of a 1,000-kw. direct-current and a 2,500-kw. three-phase turbine set, the latter supply-

ing through two 1,000-kw. Peebles motor-converters, so that there were no transformers in circuit.

The various views were taken with a 9-in. plank behind the fuses, from which the magnitude of the explosive effect can be gauged. In the case of tests M, P, and S, the arcing continued until the automatic cut-off was tripped at approximately 900, 1,000 and 1,200 amperes respectively; in several cases this happened, or the arcing continued until the fuse terminals were demolished, and it is interesting to note the high-current densities reached even with light fuses.

A number of cartridge fuses of various makes were submitted to similar tests with results distinctly in their favour, but Mr. Baynes points out that such fuses are also open to the objection that it is easy to bridge across the short break with ordinary fuse wire instead of inserting a new cartridge, thus leading to a calamity at a later date.

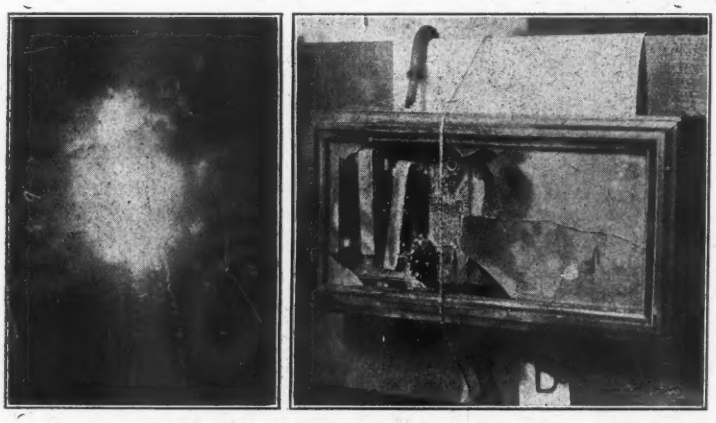
He suggests that cartridge fuses should be so designed that is impossible to short-circuit them with ordinary fuse wire.

The destructive effect of the arc, particularly in the neighbourhood of earthed metal cases, has been so great that Mr. Baynes adopted stoneware boxes for the terminal fuses to consumers' supplies, and this practice is general in the St. Pancras supply area at the present time.

We show diagrammatically a single-pole fuse box of the type referred to, the box itself being of concrete from ½ in. to ¾ in. thick, with the fuse terminals carried on iron supporting pieces which slide into grooves moulded in the box. The fuse, of the Zed type, is held in position by screwing down the milled fibre nut at the top. A concrete cover with glass inspection-window is provided. Various patterns of these boxes are made and, we understand, have given complete satisfaction.

440-volt Short Circuit on 4 in. Break; 40-ampere Fuse; Eight Strands 5-ampere Lead.

440-volt Short Circuit on 4-in. Break; 50-ampere Fuse; Ten Strands 5-ampere Lead.



Views showing Short-circuited 10-way Distribution Board; 440-volt Circuit; 2½-in. Break; 10-ampere (Two-strand) Fuses.

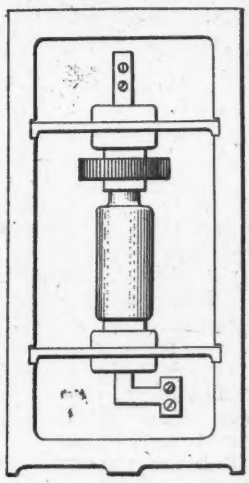


Diagram showing St. Pancras Terminal Fuse Arrangement.

Ontario Power.—An action is now pending in the Supreme Court of Ontario for an injunction to restrain the Hydro-Electric Commission and the Attorney-General of the Province of Ontario from proceeding with the Chippewa development on the ground that in the franchises of the Canadian companies, the Government of Ontario has expressly contracted never to take water from the Niagara or Welland (Chippewa) Rivers for the generation of electrical power. Bondholders in the Electrical Development Co. of Ontario will be interested in the result.—*Financier.*

AFTER FOUR YEARS.

Reflections on Chinese Engineers.

By Prof. MIDDLETON SMITH, M.Sc.

At the end of 1916, the first graduation ceremony of the British University of Hong-Kong took place. Despite the military activities of the Colony (every man eligible is a member of the local defence forces—as far as is possible) the daily routine work continues. The highest authorities have said that it is most important to maintain and develop British trade in the Far East, so as to be prepared for the trade war after peace has been signed. Before the commencement of war in 1914, China witnessed competition between the Germans and the British. In no part of the world has competition been fiercer between the two nations than in the Far East. While our enemies used their northern base of Tsingtau, we had Hong-Kong in the south. But there were many more prosperous German merchants in the British Colony than Englishmen in Tsingtau.

In 1912, feeling ran very high among patriotic Britishers in China about the neglect of the trade interests of the Empire. It was this current of public opinion that made possible the creation of the British University in Hong-Kong. The missionary scheme for a sort of International University at Hankow, espoused by Lord William Cecil, did not appeal to commercial men. It has never crystallised, and it seems improbable that the original scheme will ever become real. What practical people in China began to ask themselves, even before the war, were questions like this: "How can we extend British trade?" and "Why don't we educate young Chinese to use British machinery?" The half a-dozen English newspapers in China grew more and more insistent upon the maintenance of British interests.

It is as well to remember these things now that a great change has come over the outlook of the people of Great Britain. Since the fatal August of 1914 everyone has been making sacrifices for the sake of the Empire. But in 1912, when an appeal on patriotic grounds was made to the engineering firms of Great Britain for equipment for the University of Hong-Kong, it met with remarkable success. That was due to the immediate and spontaneous support given by the technical and lay Press, as well as to the response made by the firms to the stimulus. For it proved that most of the British manufacturing engineers were patriotic, at least two years before the general public understood what the German menace really meant. In those days some of us were, in a good-humoured fashion, chaffed about our exaggeration of the German trade bogey. But it only needed a few months of residence in the Far East to recognise its real danger.

When the first Degree ceremony of the University of Hong-Kong took place (December 14th, 1916) there were 12 graduates in engineering who were presented to his Excellency the Chancellor, and Governor of the Colony, as "worthy of the degree of B.Sc. (Eng.) in this University." They were all Chinese. The honorary degree of LL.D. was conferred on Teme Tien Yow, China's pioneer railway engineer.

The Chancellor took the opportunity publicly to thank the British engineering firms who presented equipment and apparatus. As over 200 concerns had given a practical response to the appeal, it was obviously impossible to mention them all. The three who had given equipment of the greatest value were named. They were the General Electric Co., Ltd. (England), Messrs. Ferranti, Ltd., and the Campbell Gas Engine Co., Ltd. His Excellency stated that British engineering firms had presented £12,000 worth of apparatus, while the shipping companies had brought it all out to the Far East freight free. But, perhaps, the most interesting statement made by his Excellency was the frank recognition of the influence of the Press, for he told us all that the idea of the University of Hong-Kong was first suggested in a local newsaper, the *China Mail*, in the year 1905. An Australian, named Donald, was at that time editor of the journal; but there is every reason to believe that he was inspired to write his now famous appeal for a British University as a result of representations made to him by Mr. W. L. Carter, manager of the local telephone company, who had seen service in the South African war and was a very definite Imperialist. Mr. Carter was present at the first graduation ceremony, in the uniform of a captain of the Royal Engineers, and he must have reflected upon the parable of the grain of mustard seed, for out of the original suggestion had grown the impressive ceremony which proved to the spectators that the first British University in China had commenced to send out graduates into the Far East, and the technical and lay Press have greatly assisted.

The Assistance of the Chinese.—One of the most remarkable things about this University is the enthusiasm and practical assistance of the Chinese for the Western learning which it represents. The President of the Republic sent from Pekin a poem in which, with the flowery expressions of his language, he wished success to the University. His Excellency, the Civil Governor of the adjacent Province of Kwangtung (it is one of the 18 provinces of China proper, and it contains 32 millions of inhabitants) journeyed 100 miles by river to be present at the ceremony. The hall was crowded with the leading Chinese, and, if the building had been large enough, thousands of others would gladly have been present. The most remarkable politician in China, Mr. Liang Shih Yi, was staying in Hong-Kong, although for years his had been the guiding hand on the ship of State in Pekin. He was present, and he will remember this centre of Western learning when he is again in power in Pekin.

The New China.—Europeans in this part of the world often complain that there is little evidence of change in the customs of the Chinese. It is true that the surface of the country is barely scratched. But there has been a real alteration in the outlook of the more influential Chinese. They all appreciate the value of what they call "Western Science." They are essentially men of commerce, and they are beginning to demand machinery, because they believe that it will enable them to make money. At present they are thinking about three distinct branches of engineering work. They want to see a great extension of railways; they wish to have electric light, and they are very keen upon exploiting the mines of their own country. There can be no doubt that during the next quarter of a century there will be a great demand for machinery for all three purposes. What worries a good many Britishers in China is the future. They read about the wonderful munition factories and the splendid works' organisation in the Old Country. Will it be possible to ensure that the machinery which China needs will come from those workshops? It can be arranged, if we have our trade organised in the same way as the supply of munitions for the war is now being planned out. It seems improbable that individual firms will be able to work alone. These new engineering organisations, which are paying so much attention to the trade aspects of applied science, will prove most powerful agents in the maintenance of British trade in China.

It would be churlish to let pass any opportunity for acknowledging the patriotism of the British Engineers' Association and the B.E.A.M.A. in connection with the work of the British in China. There is the motto: "Those who give quickly, give twice." No one can imagine the anxiety which was felt in 1912 about this problem of providing proper facilities for training young Chinese in Hong-Kong in applied science; and the Council of these two Associations at once exerted their powerful influence, when the problem was explained to them. The unforeseen has happened; for nobody in those days thought that the day would come when the Chinese would demand machinery which British workshops would be unable to supply. That is the present state of affairs. But the manufacturers of Britain will be glad enough of this Far Eastern market as soon as the present enormous demand for munitions is over. It is to be most sincerely hoped that they will take full advantage of it. Fortunately, the name of Britain stands high in the estimation of most of the Chinese.

So many readers of the Electrical Review have been interested in the efforts made to train young Chinese in Hong-Kong, that it is possible that they will learn with pleasure of the full advantage that is taken of the up-to-date facilities for instruction. After four years the roll of

engineering undergraduates in the University contains over 100 names. The students come from as far South as the Straits Settlements and Bangkok, as far North as Pekin and Chile, and from inland provinces such as Yunnan and Hupeh. The President of the Chinese Republic has founded scholarships, while some of the Provincial Governments have sent students, who are maintained by the public funds.

The course of instruction in engineering takes four years to complete, but it is probable that many of the students will take five years to pass the necessary examinations in order to obtain their degree. Of the 37 who commenced in 1912, 12 graduated in 1916. As all of the instruction is in English, it is, perhaps, not surprising that it takes so much time to complete the course. Many of the students show a desire to go abroad after they have graduated, and, when conditions are again normal in the works of Great Britain, it is hoped to make arrangements for these young Chinese to spend a year or two in some of the large industrial establishments. Two of the first batch of graduates have gone to America, in order to obtain some practical experience. Every facility is given to them in that country, so that they may enter into commercial relations with the manufacturing firms of the United States while there. The object is apparent. There will always be a number of young Chinese in America, because of the terms of the Boxer indemnity. But it is also very much to be hoped that, after the war, some very definite system will be inaugurated, so that the graduates of the Hong-Kong University may go to Britain.

Chinese British Citizens.—There are some millions of Chinese in the Straits, in Borneo, in Hong-Kong, and in other places where the Union Jack flies, who are British subjects. They have all behaved in a most patriotic way during the war. The idea of the aeroplane has appealed to them, and it is significant that they have given a great deal of money for the purpose of providing these machines for the front. They have made their money because of the fair and just rule which British administration provides, and they show their appreciation of it in a practical fashion. But the cult of ancestor worship is deep-seated in the heart of every Celestial. A Chinese millionaire recently died near Singapore. His body is now lying in State in Hong-Kong, and in a few weeks will pass on to the ancestral tomb at Swatow. Many years ago he left that port as a coolie. His sons now work his tin mines, his glass factory, and his rubber plantations, and they tell their friends in China of the advantages of Western science and education. The nation which provides these will obtain the trade connections.

STEAM TURBINES FOR LAND PURPOSES.

By H. L. GUY, A.M.I.Mech.E., Assoc.M.I.C.E.

(*Abstract of paper read before the* Manchester Association of Engineers.)

Some four or five years have passed since a paper on this subject was brought before your notice. It is the intention of the author to consider some of the developments which have matured in the interval.

The broad lines can be gauged by considering the difference in the production of the turbine department of the firm with which the author is associated during the period under review, confining attention to machines over 200-kw. capacity:—

	1910.	1915.
Per cent. of No. of turbines built—		
High press.	42·5	71·3
Mix press.	38·5	13·6
Low press.	8·5	1·5
Back press.	10·5	—
Reducing press.	—	13·6
Per cent. of total full-load capacity—		
High press.	74	83·3
Mixed press....	20·6	7·52
Low press.	3·5	0·18
Back press.	1·9	—
Reducing press.	—	9
Average capacity, kw.	1,550	2,300

The total output in kilowatts for 1915 was more than double that for 1910.

The reasons for these changes in the relative importance of the various types of machines are readily found. It has now been established that a pure high-pressure turbine is more efficient than a combination of a reciprocating engine exhausting into a low-pressure, or mixed-pressure turbine, with the result that high-pressure turbines are being installed where the former types were adopted a few years ago. This represents a distinct advance in the art of turbine construction, because it was still maintained at the earlier date, and with some justification, that the reciprocating low-pressure turbine combination represented the ideal.

Another factor which in many cases operates to ensure the installation of a high-pressure rather than a mixed-pressure or low-pressure turbine, is that it is often a doubtful expedient to couple a new turbine of the latter class to an obsolete, or more or less worn-out engine, which would in any case be scrapped long before the useful life of the turbine had expired.

There are, of course, certain types of modern plant at present driven by reciprocating engines which must be of the non-condensing type, such as rolling-mill or winding engines, and until these machines are electrically driven there will be a suitable field for mixed-pressure turbines in entirely new installations.

The significance of the absence of large back-pressure turbines in 1915 lies in the appearance of the reducing turbines in the latter year, which, by virtue of their greater flexibility, with very few exceptions, have valuable advantages over the former type.

One other characteristic of the change in the turbines produced in these two years is shown in the following table:—

Date.	% of number of machines built. 3,000 r.p.m.	1,500 r.p.m.	Average output of each machine. 3,000 r.p.m.	1,500 r.p.m.
1910	46·8	19·2	588	2,800
1915	76·0	15·2	1,810	5,300

The continuous tendency towards increased outputs at high speeds exhibited by these figures is responsible for many of the changes in design which have taken place. The object of this development is revealed by the curves shown in fig. 1, where the upper two curves show the steam consumption

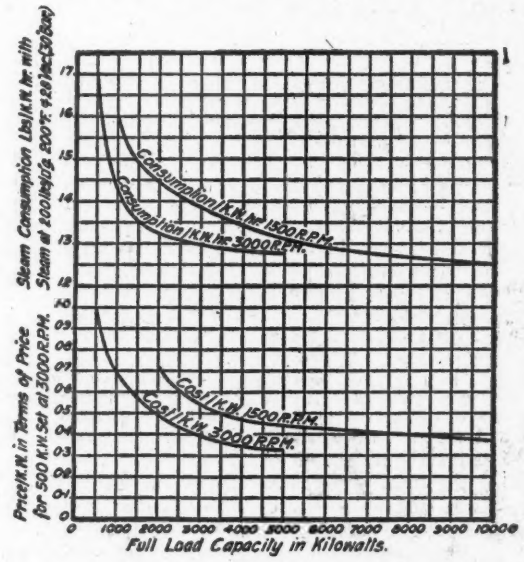

Steam Consumption Lbs/K.W. hr with Steam at 200 lbs/sq. inch Superheat 250°F.
Consumption K.W. hr 1500 R.P.M.
Consumption K.W. hr 3000 R.P.M.
Price K.W. in Terms of Price for 500 K.W. Set at 3000 R.P.M.
Cost / K.W. 1500 R.P.M.
Cost / K.W. 3000 R.P.M.
0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Full Load Capacity in Kilowatts.

Fig. 1.—Effect of Speed on Steam Consumption and Cost of Turbo-alternators.

obtained for the steam conditions stated, with turbo-generator sets of various outputs at 3,000 and 1,500 r.p.m., while the lower curves show the variation in cost per kilowatt of turbo-generator sets at these two speeds.

It will be seen that at 3,000 kw., the steam consumption with a 3,000-r.p.m. set is 6.15 per cent. better than at 1,500 r.p.m., while the cost per kilowatt is 27.8 per cent. lower. For a 5,000-kw. set, the steam consumption at 3,000 r.p.m. is 2.67 per cent. better than at 1,500 r.p.m., and the cost per kilowatt 26.2 per cent. lower. The curves shown give safe values of the present steam consumption and cost ratios, but it should be remembered that as the number of frames available is not unlimited, these curves should really be stepped lines, and that as various values are set on steam consumption by different purchasers, a manufacturer may use several frames for the same output, which results in different steam consumption, and therefore price per kilowatt being given. The relative sizes of a 5,000-kw. set at 3,000 r.p.m. and at 1,500 are illustrated in fig. 2.

The way in which increasing the output at high speeds reacts on design can be illustrated by considering the effect upon various types of blading.

The output which can safely be obtained at a given speed and vacuum is limited largely by the effect upon the last

row of blades. If the safe length of blades is fixed, the volume of steam which can be passed through the last row can only be increased, and with it the output of the machine at a given vacuum, by increasing the velocity of the steam through the blades.

Now the kinetic energy of the steam leaving the last row of blades passes straight into the exhaust, and represents a dead loss in efficiency. This is called the "leaving loss," and must be kept small if a reasonable turbine efficiency is to

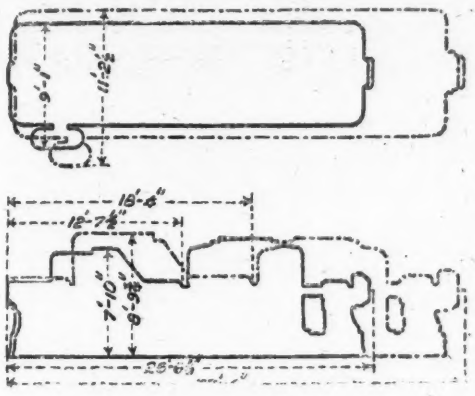


FIG. 2.—EFFECT OF SPEED ON SIZE OF TURBO-ALTERNATORS.

be obtained. On the other hand, if the leaving loss is reduced by increasing the blade length, the factor of safety in the blade must be sacrificed. In fig. 3, the leaving loss has been plotted for two types of blade fastenings, and two standard blade materials, against the corresponding output of the turbine, assuming that the factor of safety in the complete blade is to be three on the elastic limit. This factor of safety has been chosen as reasonable, and is justified by an extensive experience.

Suppose we fix on a leaving loss of 1½ per cent. as being a proper value, then with nickel-steel blading, a turbine of 5,000 KW. output can be built, having a forked blade, or

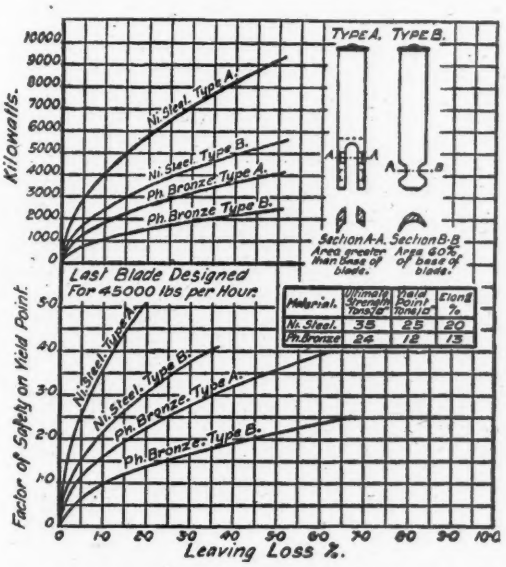

Kilowatts.
Factor of Safety on Yield Point.
Leaving Loss %.
Ni. Steel. Type A.
Ni. Steel. Type B.
Ph. Bronze. Type A.
Ph. Bronze. Type B.
TYPE A. TYPE B.
Section A-A. Section B-B
Area greater than base of blade.
Area 60% of base of blade.
Last Blade Designed For 45000 lbs per Hour.
Material. Ultimate Tension Tons/□"
Yield Point Tons/□"
Elong. %
Ni. Steel. 35 25 20
Ph. Bronze 24 12 13

FIG. 3.—LEAVING LOSS AND STRESSES IN LAST ROW OF TURBINE BLADES.

3,000 R.P.M., 28 in. vacuum.
Factor of safety = 3 on yield point.
Steam consumption = 13 lb./KW. hour.
Adiabatic heat drop = 381 B.TH.U./lb.

2,000 KW. with a dovetail blade; with phosphor-bronze the maximum output is 2,250 KW. for a forked blade and 1,350 KW. for a dovetail blade.

If the turbine, having nickel-steel dovetail blades, is rated at 5,000 KW., the leaving loss, and therefore the steam consumption, will be 2.7 per cent. greater than with forked blades, having the same factor of safety of three on the elastic limit. The curve also shows that phosphor-bronze is inadmissible for outputs greater than 3,000 KW., even when forked blades are used. For mixed-pressure and low-pressure turbines, the output given should be reduced by one-half. For vacua other than 28 in. the leaving loss varies as the square of the specific volume of the steam leaving the last row, so that the output for a given leaving loss approximately varies inversely as the square of the absolute pressure. The output which can be obtained with a given factor of safety and leaving loss varies directly as the strength of the material used for the blades, and is independent of their mean diameter.

The same results are exhibited in another way in the lower half of fig. 3, which shows that with a leaving loss of 1½ per cent., the factor of safety on the elastic limit will be 4.5 for nickel steel forked blades, or 1.2 for bronze dovetail blades.

The present position of high-pressure turbines can, perhaps, be most readily appreciated by considering certain typical installations.

The first instance is a 2,000-KW. British Westinghouse Rateau impulse-type turbine, running at 3,000 R.P.M., and installed in a typical industrial power station. The steam conditions are 160 lb./sq. in. g., 160 deg. F. superheat, 28-in. vacuum, and the generator works at 6,600 volts, 50 cycles, 3-phase. The rotor consists of a two-row velocity wheel, followed by seven Rateau wheels, the first blade being 13/16 in. high, and the last 6⅞ in. Six months after the plant was first started up, a 24-hour test was made, under ordinary working conditions. The following results were obtained:—

Efficiency of boilers, 69.83 per cent.

Coal per KW.-hour, 2.1 lb.

Steam per lb. of coal, 8.35 lb. The feed water metered included that required for all the auxiliaries, feed pumps, drains, &c.

In January, 1915, a 3,000-KW., 3,000-R.P.M. set supplied to the Charing Cross, West End & City Electricity Supply Co., Ltd., was started up. The turbine was of the impulse type, containing 11 Rateau stages. The steam conditions were 170 lb., sq. in. g., 55 deg. F. superheat, 27¾ in. vacuum.

This was one of the first sets of this speed and rating running in this country. The auxiliary turbine was designed for 220 B.H.P., at 2,500 R.P.M., rather a high output for such a set, due to local conditions.

The guarantees included the steam required for the auxiliary turbine, which exhausted into the main turbine at a stage where the pressure was atmospheric at full load. The official test results corrected to guarantee conditions were as follows:—

Load.	Overload.	Full.	Three-quarter.	Half.
Test result, lb./KW.-hour	15·9	15·9	16·7	19·13

A 5,000-KW. set at 3,000 R.P.M., installed in the Stuart Street power station of the Manchester Corporation, was started up in October, 1915. Between November 22nd, 1915, and November 13th, 1916, this set generated 22,293,400 KW.-hours, or 49.4 per cent. of that possible if it had been on full load for the whole of the time between those dates.

The success of impulse turbines has been in a large measure due to the fact that the pressure and temperature inside the turbine casing are kept low by allowing a much larger expansion in the first than in succeeding stages, with the result that the full boiler steam pressure and temperature are confined to the steam chest and nozzle boxes, which are small chambers, and can when necessary be made of cast steel at a reasonable cost. In turbines whose blades rotate at a moderate peripheral speed, the steam velocity resulting from this large initial expansion can be utilised most efficiently in a velocity wheel having two rows of moving blades, but with a given expansion, as the peripheral speed of the blade increases, the work done in the second row decreases, whereas the friction and windage losses increase as some power greater than the cube of the speed, and a point will be reached when the second row of blades does not perform enough work to rotate it at the required speed, the deficit being made up by the first row.

With the conditions stated and with blades having 30 in. mean diameter, the addition of the second row increases the stage efficiency by 25 per cent., but if the mean diameter is 47 in. the second row makes no contribution to the work done, so that it can be dropped with advantage.

(To be concluded.)

BOILER-HOUSE OPERATION AND MAINTENANCE.

IN a paper read before the South African Institution of Engineers recently, Messrs. T. G. OTLEY and VERNEY PICKLES discussed the methods of boiler operation and maintenance adopted in the power stations of the Rand Power Companies* and the efficiencies obtained; the following is an abstract of their remarks:—

The plants referred to are at the Brakpan, Simmerpan, Rosherville, and Vereeniging power stations, the first-mentioned being the earliest built, and having a parallel boiler-house design originally intended for only two 3,000-KW. sets.

The lay-outs of these four plants are shown in figs. 1-4; the authors advocate that the boiler houses of large stations

* Victoria Falls and Rand Mines Companies. The stations were described in the ELECTRICAL REVIEW of March 28th, 1913.

should be built at right angles to the turbine house, as with 10,000-12,000-KW. turbines, about 280 KW. of turbines is installed per foot run of house, whereas with boilers of about 6,000-sq. ft. heating surface the boiler KW. per foot run is 80-90. Table I contains data bearing on this point.

TABLE I.—Turbine and Compressor Houses.

—	KW. installed.	Length of turbine house.	KW. per ft. run.	KW. per sq. ft.	Plant installed (turbo-generators and compressors).
					KW.
Rosherville ...	87,000	404	216	2·86	5 × 9,600 T.G. 6 × 3,000 C. 3 × 7,000 C.
Vereeniging ...	43,500	153	273	3·78	2 × 9,600 T.G. 2 × 12,000 T.G.
Simmerpan ...	40,000	327	122	2·10	2 × 12,000 T.G. 6 × 3,000 T.G.
Brakpan ...	31,000	325	95	2·64	2 × 12,500 T.G. 2 × 3,000 T.G.
Total installed	201,200				

Boiler Houses.

—	No. of boilers installed.	*Nominal capacity of boilers at 15 lb. per KW.	Area of boiler houses, sq. ft.	KW. per sq. ft.
Rosherville...	40	89,600 KW.	46,482	1·93
Vereeniging	20	48,000 ,,	24,168	1·98
Simmerpan...	24	42,600 ,,	28,980	1·47
Brakpan ...	18	37,000 ,,	21,840	1·68
Total ...	102			

* The nominal capacity is considerably less than the actual evaporation obtained in practice when burning reasonably good coal at normal draft. For instance, it is possible to obtain an evaporation of 50,000 lb. per hour from boilers rated at only 36,000 lb.

At Simmerpan 16 small boilers are installed in two boiler houses, and eight large boilers in a third boiler house. The KW. installed per sq. ft. in the small boiler house is 1·22, and in the large boiler house 1·78.

At Brakpan the eight small boilers occupy an area which gives KW. per sq. ft. = 1·39, and the 10 large boilers KW. per sq. ft. = 2·00.

At Brakpan, 40 or 50-ton capacity trucks can be shunted up an embankment over the bunkers, four of which contain 120 tons each, and five, 375 tons each; this arrangement, though simple on paper, is most inconvenient in practice, with a consumption of up to 6,000 tons per week, due principally to the impossibility of mixing the coals to obtain most efficient results.

The arrangement is a good one as regards coal-handling costs, but shunting charges are heavy.

An outside storage with elevators and conveyors would have reduced shunting, but increased the handling charges. The principal gain would have been in efficiency due to the possibility of mixing the coal, which would have paid a very handsome return on the additional capital cost.

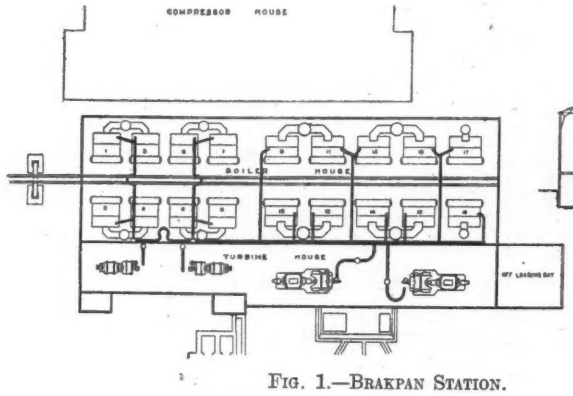


Fig. 1.—Brakpan Station.

An outside coal storage arrangement is provided at Simmerpan, consisting of a concrete and steel bunker having a capacity of 3,240 tons. Gravity bucket conveyors run underneath and deposit the coal to any one of the three gravity bucket elevators and conveyors taking coal to the overhead bunkers of the three boiler houses; several fillers are provided, so that alternate buckets can be filled with different coals. The arrangement has worked perfectly and without trouble.

All coals burnt at Simmerpan are either duff or a mixture of duff and peas. The experience is that such coals can be burnt more efficiently when moistened.

At Rosherville the bunkering arrangements are generally similar to those at Simmerpan, except that the five staithes are in line with the centre lines of the five boiler houses, and that the outside storage is not in the form of a bunker. Gravity bucket conveyors run underneath the coal staithes, and the elevators convey the coal into the overhead bunkers above each boiler house. The gravity bucket type of elevator and conveyor in practice has been found so reliable that the consulting engineer for the Rosherville station deemed it unnecessary to have any considerable inside storage over the boilers.

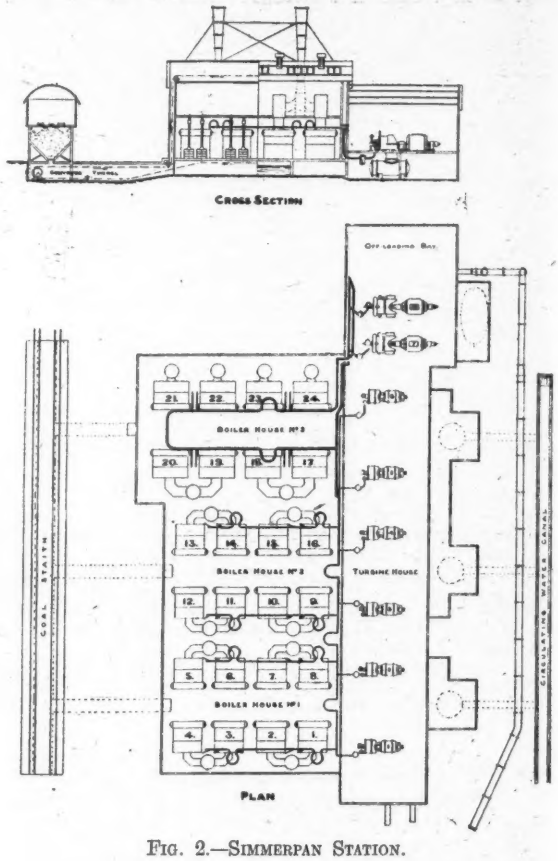


Fig. 2.—Simmerpan Station.

There is considerable difference of opinion as to the advantage or otherwise of large overhead bunkers. In our opinion, the local conditions are the deciding factor. Where land is relatively cheap, there is no doubt that an outside bunker is much the better arrangement, as not only can larger tonnages be more easily stocked, but the cost of the building steelwork is largely reduced, and a lighter and cleaner boiler house results. The tendency in modern practice is, where possible, to store coal outside and have only the minimum inside storage. In this case, the conveyors and supporting structure and the small coal bunkers and chutes connecting them to the stoker hoppers, can be suspended from the roof principals. A further advantage of outside storage with minimum inside bunker is that one can draw upon any particular coal at any time with the certainty that it will reach the boiler to meet sudden changes of load, whereas with large overhead bunkers the choice of coals is somewhat restricted. The first four boiler houses at Rosherville have only very limited inside storage; the fifth boiler house is provided with an overhead bunker capable of holding 800 tons. As the boilers in this house are steamed steadily and continuously, there is no very great disadvantage in the overhead bunker, although it is not necessary, and certainly added considerably to the capital cost of the buildings, and interferes with the natural lighting.

At Vereeniging the outside coal staithes are very similar to those at Rosherville, being arranged in line with the centres of the two boiler houses. Bunkers are also arranged over the boiler houses, each of a capacity of 1,000 tons. In this case, also, the authors say they could have been dispensed with; they interfere somewhat with the light, and added consider-

ably to the capital costs of the buildings. The authors' experience with gravity bucket elevators and conveyors has been almost uniformly satisfactory. They must be kept clean and well oiled; automatic oiling devices are unreliable. The

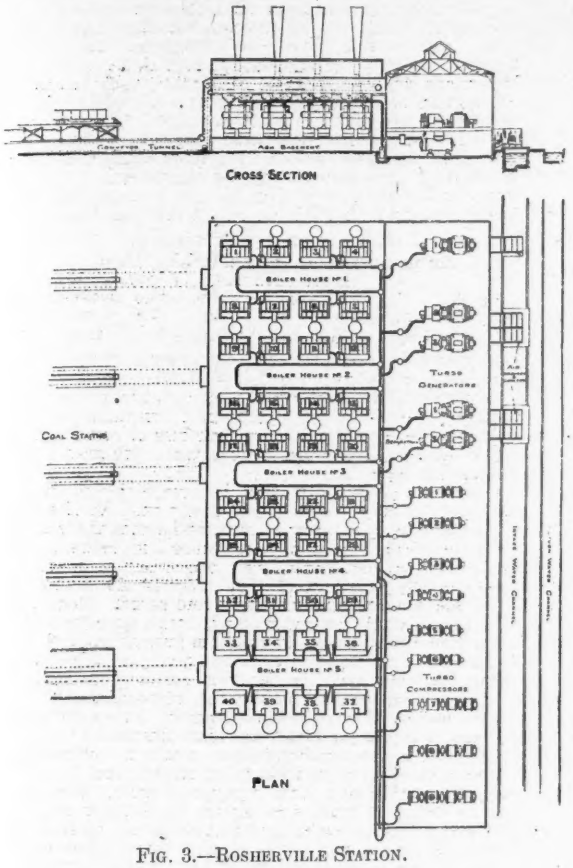


Fig. 3.—Rosherville Station.

bushes last about four years with continuous running; the material is usually too soft, and some trial case-hardened bushes show no signs of wear after several months' use.

Twelve conveyors, totalling 7,210 ft. in length, handled 828,733 tons in 1915 at a cost of .780d. per ton delivered into overhead bunkers.

Knowledge of boiler-house efficiency is wholly dependent upon correct weighing of coal, and very considerable errors can be made when 1,000-1,400 tons per day are handled.

At Brakpan and Simmerpan the coal is measured by levelling the bunkers, which are calibrated to definite volumes per foot depth. For small bunkers this method gives accurate results.

Blake-Denison continuous weighing machines are provided at Rosherville and Vereeniging, and with great care and frequent calibration, and a knowledge of the bias of the machines, a fairly reliable return can be obtained.

The stocks at Rosherville and Vereeniging are checked at the end of each quarter by a careful survey. It is not unusual to find an error of between 1,000 and 2,000 tons either plus or minus. This would represent a continuous error of between 1 and 2 per cent.

The bulk of the coal is delivered in 40 or 50-ton hoppers filled right up; the weights delivered agree fairly well with those on the weigh bill.

At the earlier stations—Brakpan and Simmerpan—measuring drums were fitted; these proved unsatisfactory, as the duff coals do not run freely, especially when wet, so that the drums did not fill properly. All subsequent bunkers were provided with the Babcock and Wilcox coal valve. The authors find that the makers usually provide chutes of too thin a plate—¼ in. or 3/16 in.—and as a result, they are rapidly corroded away on the bottom side, especially when dealing with wet coal. At Vereeniging the coal chutes are rectangular in section, which renders them much easier to repair. In the earlier installations the discharge end was splayed to about half the width of the stoker hopper; this gave an unequal distribution of coal, the peas or larger pieces of coal falling to the sides, and the duff and powder falling in the centre, resulting in uneven fires. An improvement has been effected by making the width of the splayed bottom equal to the full width of the stoker hopper, but even with these there is a tendency for the larger particles of coal to fall to the side and make a somewhat uneven fire.

(To be continued.)

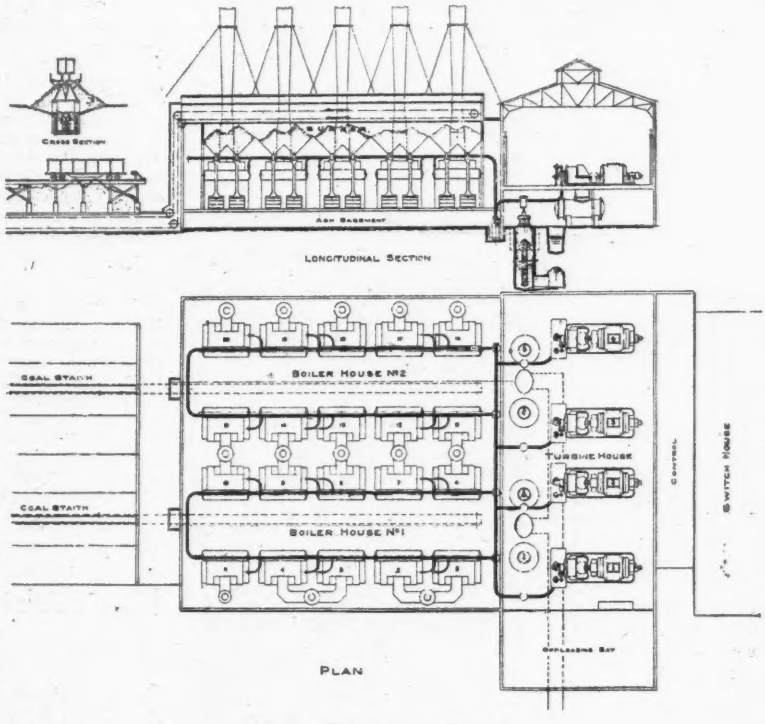


Fig. 4.—Vereeniging Station.

THE FIRST LONDON ENGINEER VOLUNTEERS.

In the course of an article on the work of this Corps during the past year, Macleod Yearsley, Adjutant, states that the First London Engineer Volunteers has reason to be proud of the work which it has done during 1916. The year has been largely one of organisation, and, indeed, an anxious one for those in authority. In January, 1916, there were two Corps occupying jointly the headquarters in Eccleston Place—the Fourth Battalion, Central London Volunteer Regiment, and the Engineering Institutions Volunteer Engineer Corps. They drilled and did much of their work together. The former body had only just been formed from the remnants of the Architects' and London County Council Corps, which formed two Companies. There were many difficulties in the way of good organisation, however, partly because there was in the air a prospect of amalgamation of the 4th C.L.R.V. with the Electrical Engineers, and partly because, in this expectation, no responsible Commandant had yet been appointed. It is not surprising, therefore, that for the early part of the year a spirit of unrest was abroad. Although work was carried on, it was only because the officers were keen and zealous that any real progress was made.

But in May the period of unrest came to an end. The old 4th C.L.R.V. and E.I.V.E.C. became incorporated as the First London Engineer Volunteers, and, for the last six months, the progress of the Corps has been both real and apparent. Under the firm but kindly rule of Lieutenant-Colonel Clay, the work of reorganisation has been successfully accomplished, and the Corps has received the approval of its inspecting officers. The County Commandant, Sir Desmond O'Callaghan, K.C.V.O., who has officially inspected the Corps, both on parade and at its work in headquarters, has expressed himself as "entirely satisfied with all he saw."

The work that has been done during the past six months may be divided into drill and technical work. The former is good, and has improved decidedly during the past three months, an improvement which the institution of N.C.O.'s Classes must tend to increase. The technical work has been

largely in the form of entrenching on Sundays, and such elementary instruction in bridging as can be given at headquarters, together with theoretical instruction in the form of lectures. The entrenching work at Otford (in connection with which a very successful camp was held in August) has reached a high order of excellence, and has been warmly commended by the London Defence Authorities. Other technical instruction has not, perhaps, progressed so well, but this is a defect that will be remedied in the near future.

The work of the Searchlight Classes is of great value, and is regarded as a valuable asset to the Corps. Originally the special department of No. 3 Company (the old E.I.V.E.C.), these classes have been thrown open now to the whole Corps, and sappers wishing to join have only to apply to their company officers and to await vacancies, as the number that can be accommodated in each class is limited. Musketry has been well looked after by Mr. A. Gerard, the Instructor of Musketry, to whose zeal and efficiency the Corps is greatly indebted.

Those who are responsible for the programme for 1917 are making every effort to ensure a good, practical, and progressive training, which shall make each man in the Corps a fair practical engineer-soldier in as short a time as possible—*provided he chooses to avail himself of his opportunities.*

Theoretical instruction will be given at headquarters, to be supplemented by practical instruction in camp. Drill will be well looked after, musketry will "carry on," and there will be an additional incentive to good work by reason of the struggle of the three Companies to hold the Commandant's Cup. *But*, it is all good opportunity wasted if full advantage is not taken of it.

Two things are wanted: more recruits and better attendance. As to the former, there are plenty of men, over military age, who ought to be in a Volunteer Corps. They are the men who groan to their friends because they are "too old" to serve their country. Suggest volunteering to them and they reject the proposal with scorn as "playing at soldiers." The real fact is, says the Adjutant, that they are just "slackers," and do not intend to serve in any capacity. But there is a time coming when they will be shaken out of their nests and made to serve. Why do they not come voluntarily before they are forced? This kind of person does *not* serve by "only standing and waiting."

The Corps should double its strength in the next twelve months; and it is a Corps that any man should consider it a privilege to join.

As to attendance at drills, the Commandant has been sorely disappointed at the small uniform parades that have been the rule. If the Corps is to do good work in 1917, the attendance *must* be better.

We may add to the foregoing remarks that this Corps is pre-eminently the Corps for electrical men to join, in order to apply their knowledge to the best advantage. As for present-day volunteering being only "playing at soldiers," this is not only a false impression—it is a gibe which perpetrates a cruel injustice to the men who have given up their spare time, in the face of official discouragement, to training and trench-digging. Fortunately, the recent appeal of the King for more Volunteers, together with the issue of the regulations under which the Volunteers are officially constituted an integral and essential component of the military forces of the country and charged with the duty of its internal defence against invasion, has put an end once for all to the sneers of the lethargic, and those who enlist as Volunteers "for the period of the war," and carry out the prescribed course of training, are undoubtedly serving their country in an honourable and useful capacity.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Variable-Speed Polyphase Motors.

I note with great interest, in your issue of January 12th, the description of a polyphase commutator motor, with variable-speed shunt characteristics, manufactured by the B.T.H. Co. One may presume that this motor is of the "Schrade" type, similar to that now being marketed by a Continental firm.

The writer has studied the question of A.C. variable-speed motors, with and without commutators, for a considerable time, and perhaps a few remarks as to the possibilities and limitations of various types of motors may be of interest to your readers.

Some months ago an article was published in your columns (July 14th, 1916) descriptive of a new variable-pole induction motor, of the writer's design, in which every polarity is available, and which is now being marketed by Messrs. F. Parkinson & Co., Guiseley. This type of machine the writer considers to be the most satisfactory for large outputs, where the cost of a commutating machine having completely sparkless operation would be prohibitive. It seems probable that in the smaller sizes, and for high speeds, where the number of speeds available in a variable-pole machine is small, and the relative cost of the control gear considerable, a commutator machine such as that developed by the B.T.H. Co. is the right solution of the problem. For instance, small 500 to 1,500-R.P.M. motors form an ideal application for the commutator machine. In certain cases, too, the gradual speed regulation attainable would be an advantage. These cases are fewer than would be supposed at first sight. Thus, the two types are complementary to each other, each having its own field, and both being necessary to a complete solution of the problem of polyphase speed variation. There will, of course, be a certain not very wide debateable ground, and in view of its existence, a somewhat more detailed comparison of the two types may perhaps be of interest.

Comparing the particulars given in your issues of July 14th, 1916, and January 12th, 1917, we obtain the table below:—

POWER FACTOR AND EFFICIENCY.

H.P. proportional to speed in both machines.

Speed.	Variable-pole motor. Top.	Medium.	Low.	Commutator motor. Top.	Medium.	Low.
Full-load P.F. ...	85	80	63	1·0	86	67
„ efficiency	85%	81%	72%	84%	81%	77%

Bearing in mind that we are comparing a 50-H.P. motor with a 20-H.P. motor, we see that the difference is a great deal less than might be imagined. The commutating machine has better power factor at high speeds, but probably about the same at low speeds, while for machines of equal size the induction motor would probably give better efficiency at all speeds, low or high.

As regards starting and acceleration, we may note that it is as easy to build a variable-pole motor with wound rotor and slip rings as with squirrel cage, and hence the starting torque is identical with that of a standard induction motor, while the current, in a 3 to 1 speed range machine, is reduced to approximately one-third of that required by a standard motor of the same maximum output and speed. Hence, the starting of the variable-speed motor is much superior to that of a standard type. By an appropriate form of control gear, both the rate of acceleration and the current absorbed when changing from one speed to the next are kept under exact control, absolutely gradual acceleration being attained.

A point worthy of note is the extremely low speeds of the 50-H.P. and 30-H.P. commutator machines illustrated. This is, of course, due to the requirements necessary to obtain sparkless commutation in a variable-speed machine on 50 cycles, namely, low speed and a large number of poles. The writer has no hesitation in placing in service single-phase machines of double this capacity, operating at 1,000 R.P.M. on 50 cycles, but these, of course, run in the neighbourhood of synchronism, the commutating condition of variable-speed machines being much more severe. Even in a size so small as 50 H.P. the cost of control gear in a variable-pole machine becomes relatively moderate, while the motor can be built for much higher speeds. Hence, except in those few cases where absolutely gradual speed variation is necessary, it would tend to be preferred, the comparison inclining more and more towards the variable-pole machine the larger the installation. The two types, of course, represent two different dispositions of the switchgear necessary to obtain variable speed, since the commutator is itself essentially a switch. In one case the switchgear is made an integral part of the motor, and is in continuous operation. In the other, the switchgear is separate, and operates only when a change of speed is desired. Between the two, engineers may congratulate themselves that the difficult problem of a variable-speed motor is rapidly approaching solution.

F. Creedy.

Guiseley, *January 30th*, 1917.

Cheap Water-Power.

Can any of your readers offer advice on the following:—I am in charge of an undertaking in a small country town where formerly water power was used for generating the current. On account of the water power being unable to meet the demand, and the transmission line (four miles long) needing complete reconstruction, the water was abandoned in favour of suction gas. The actual water-power generating plant is, however, still in exceedingly good condition, and as, owing to the great cost which removing the turbines from their position would entail, the plant has very little market value, it has been suggested that the available current might be used for some electrochemical process. About 60 KW. at 2,500 volts single-phase, at very low running costs, could be obtained as the plant stands, and I should be glad if any reader could suggest a purpose to which a small quantity of power like this could be profitably put. The power will have to be used on the site, if at all.

Water Power.

Federal Income Tax.

I have pleasure in advising you that the efforts of this Association have been successful in having Section 15 of the Income Tax Assessment Act, 1915, repealed.

You will recollect that Section 15 provided that in the case of a person selling goods in Australia on account of a person not resident in Australia, the principal should be deemed to

have derived from such sale a taxable income of 5 per cent. upon the price at which the goods were sold, that the person selling the goods should be personally liable for the payment of the tax to the extent of the tax payable on goods sold by him after June 30th, 1915, and that goods should be deemed to be sold in Australia on account of a person not resident in Australia if any person in Australia received a commission in respect of the sale of the goods, or was paid a salary for obtaining orders for or for influencing the sale of the goods.

Under the provisions of the Act, as now amended, neither the agent nor the overseas principal is taxable on any profit made by the overseas principal on the sale of goods through an agent in Australia.

R. H. Butler, *Secretary.*
The Australian Association of British Manufacturers and their Representatives.

Melbourne, *December 20th,* 1916.

Accuracy of Steam-Flow Meters.

In view of the lack of confidence in steam-flow meters, shown by the discussion on Mr. Lackie's paper at last year's meeting of the Municipal Electrical Association, the following results of some tests we have recently carried out on a steam-flow meter may be of interest to your readers.

This steam-flow meter has been installed in connection with a 3,000-KW. turbo-generator, and as we have a Lea recorder, through which the whole of the condensed steam from the turbo-generator can be passed, we can check the quantity of steam recorded by the steam meter against the quantity of water recorded by the Lea recorder.

The following are the results of several tests, the differences being given as percentages of the full scale reading of the instrument, which is 60,000 lb. of steam per hour:—

Lea recorder, lb. per hour.	Steam-flow meter, lb. per hour.	Difference as percentage of full scale reading.
16,273	15,026	2.1 per cent. –
17,781	16,330	2.4 per cent. –
30,871	30,562	.5 per cent. –
32,460	31,606	1.4 per cent. –
32,560	31,900	1.1 per cent. –
40,905	41,503	.99 per cent. +

J. R. P. Lunn,
Borough Electrical Engineer.

Darlington, *January 30th,* 1917.

Profit-Sharing.

We notice in your issue of January 19th reference to a pamphlet on "Capital and Labour," by Sir William Lever, Bart., in which he advocates profit-sharing as the cure for industrial unrest. With this we are in complete agreement, but how can an industry share profits when none are made? Sir William Lever is, luckily for himself, engaged in an industry which yields enormous profits (and not to one firm only), and did so in competition with Germany. Are we to assume that this is due to the superior intellect and ability of soap manufacturers as compared with electrical manufacturers, or to natural or artificial advantages? As Sir William Lever has been reported as advocating trading with Germany after the war, and a continuation of dumping, and, further, to have said that dumping harms Germany and benefits us, will he explain how an industry which is subject to dumping and State-aided competition is to work at a profit? In considering this point, it is necessary to take a modern industry equally suitable for both countries, and not an old-established one which is protected by goodwill and experience, nor one with any natural advantages.

If our destinies are to be controlled in the future, as in the past, by that little clique of Free Traders whose fiscal fallacies are on a par with the rest of their false conceptions during the last 35 years (*i.e.*, since Germany became an industrial nation), even the best form of industrial co-operation will not ensure industrial harmony.

Mr. John Hodge, our Labour Minister, said last week:—"I am one of those silly people who once went to Germany on a peace mission." Previous to the war, like the silly beggars they were, the Labour men thought Free Trade meant the prevention of war. But the war had dropped the scales from their eyes. He was going to have no more German steel in this country while there was an idle furnace here. So-called Tariff Reform did not mean the lowering of the standard of life, as some people seemed to assume.

Mr. Hodge thus admits that his own opinions have changed, but evidently one of the first essentials is to convert the workers and voters to the necessity for protection for all suitable industries which are subject in any form to unfair competition.

Electrical Manufacturer.

Australian Agencies.

Before returning to Australia I am anxious to obtain the sole representation of a good electrical manufacturing firm—particularly metal filament lamps—for the Commonwealth of Australia, and am appealing to you for your kind assistance. I can furnish any references and guarantees which may be necessary.

At the moment, I believe there is some difficulty in exploiting goods from this country, but British manufacturers should remember that America and Japan are flooding the Australian markets, and unless the home manufacturer shows that he is taking some little interest, even at the present time, in the Colonial firms he may find great difficulty in securing ready markets after the war.

I am in the position to influence quite an amount of business in the Australian market.

Even if very little can be accomplished now, everything can be got ready for that time when business will be very acceptable.

A. H. C.

[Any replies to this letter that we may receive will be forwarded to our correspondent.—EDS. ELEC. REV.]

Women and "Shorts."

I have read the letter under this title in your last issue emanating from the pen of someone, supposedly a male, masquerading under the *nom de plume* of "Exciter," and my first impulse was to wonder how your highly reputable journal printed any such garbage without reference to the facts, which were easily obtainable.

Acting on the urgent demands of the military authorities, Marylebone responded energetically, and, I should say, successfully, in releasing men wherever possible by employing women. The "short" referred to developed in our mains in another part of the borough, and, incidentally, severed the telephone wires between the sub-station, where women are employed, and the generating station. The woman in charge, with commendable initiative, sought the nearest call office, and thereby conveyed the necessary information to the station engineer, securing continuity of supply in record time.

The matter was investigated by my Committee, who congratulated the officers and staff on the result.

The lurid and inaccurate description by "Exciter," in the light of my explanation, can be regarded as just so much silly drivel.

Duncan Watson,
Chairman of Electricity Committee,
Marylebone Borough Council.

London, W., *February 6th,* 1917.

[While we regret the injustice done to the women by "Exciter's" incorrect version of the incident—which we regarded as a jocular effort on his part—we are glad that it has drawn from Alderman Duncan Watson a statement which not only vindicates the sub-station attendant, but also clearly demonstrates her efficiency in an emergency.—EDS. ELEC. REV.]

Localising a Fault.

Your correspondent "Mains Assistant" asks for a simple method of locating, in the future, a fault such as he describes. His testing apparatus seems to be short of a Wheatstone bridge, which, I think, would have solved the difficulty. He states that burning-out and a loop test were for various reasons impossible. The instruments available evidently did not meet the case, as the fault was discovered by chance. He does not state if the resistance of each conductor was known; if so, as the cable was completely shorted, the bridge test would have served the purpose. Further occurrences of a similar nature and method of testing would be interesting.

H. Payn.

B.E.F., France, *February 1st,* 1917.

In answer to "Mains Assistant's" letter under the above heading, appearing in your issue of the 26th ult., I think the simplest and most reliable method to use in testing for a triple short and dead earth on triple-concentric cables is the following:—

Pass a current of about 5 amperes through a bank of lamps, or suitable resistance, from the live main to one core (say x) of the faulty cable, whence it will pass through short to earth, or use a battery connected across x and o cores.

We will assume here that the fault lies beyond the first x consumer.

With a galvo. or sensitive and low-reading voltmeter take the drops, (*a*) across x and o cores of the faulty cable at the testing station, (*b*) across the cut-outs of the first x consumer's service, and (*c*) across x and o at the far end of main. This last reading gives the drop across the fault, and is subtracted from (*a*) and (*b*).

Now, if the results obtained from (*a-c*) and (*b-c*) are plotted, taking drop vertically and distance from testing station horizontally, then a line drawn through the dots when produced cuts the horizontal at a point which gives the distance to the fault.

I may say here, I think it advisable to take as many readings as there are x consumers as a check.

If the fault lies nearer the testing station than the first x consumer, then the readings (*b*) and (*c*) will be the same,

and a test taken from the other end will give the necessary information, or, alternatively, a known resistance can be inserted between the lamps and faulty cable and equated to terms of length of the cable. This method also applies when there are no consumers connected to the main, or no points where readings can be obtained.

Of course, when the current is accurately known, and the drop taken with a voltmeter, then the resistance of the cable from testing station to fault can be found and worked out in terms of length.

The points to be remembered in this test to ensure reliable results are that the short must be steady, and great accuracy is needed in reading the drop, as this is extremely small. If the short is not steady, then using a Megger across the cores is a great help in cleaning and steadying the fault.

Using a battery is, perhaps, the better way, as the drop is steadier than when employing the main, especially in the daytime, when there is a motor load in the vicinity of the fault.

The method described by Mr. Wardle in last week's issue has the disadvantage of not eliminating the resistance of the fault, which, if considerable, will greatly affect the reliability of this method.

W. Leighton Chubb.

Maidenhead, *February 5th*, 1917.

WAR ITEMS.

Exports to China.—In the "London Gazette" for February 2nd there appear additions to the list of persons and bodies to whom exports to China and Siam may be consigned.

Lighting Restrictions.—In a lighting restrictions prosecution at Keighley last week, it was stated in evidence that the defendant had turned on 17 electric lights in order to attend to the boilers at a certain industrial works. The fine was 18s.

Trading with the Enemy.—The "London Gazette" for February 2nd contains further lists of persons or bodies with whom trading is prohibited in Argentine and Uruguay, Brazil, Chile, Denmark, Japan, Morocco, Norway, Peru, Spain, Sweden, &c.

Exports to Australia.—The Ministry of Munitions announces that as from January 31st, 1917, no application for priority certificates for the manufacture and export of goods to Australia will be entertained unless the application has been endorsed by the Director of Munitions, Collins House, Collins Street, Melbourne, Victoria.—*Birmingham Daily Post.*

Ministry of Munitions and Lead.—The Minister of Munitions has ordered that the sale or purchase of lead, except in accordance with a licence or for the purpose of carrying out a written contract existing prior to the date of the Order, is prohibited. Until further notice, too, there must be no use of lead for manufacture without a licence, unless for necessary repairs, involving the consumption of not more than 1 cwt. or for type-casting from lead already in that form or previously purchased for that purpose. Monthly returns of lead in stock, &c., and contracts and orders, will have to be made, unless the total stock in hand or order for future delivery has not exceeded 1 cwt. Applications for licences must be made to the Director of Materials at Hotel Victoria, Northumberland Avenue, W.C.

Ministry of Munitions and Locomotive Engines.—The Minister of Munitions has issued an order that all persons (other than railway companies) owning or having in their possession or under their control any steam or petrol locomotive engine or engines in Great Britain shall within ten days from February 2nd send in to the Deputy Director-General of Railway Material Licences, Ministry of Munitions, Whitehall Place, London, S.W., returns containing the following particulars with regard to such engine or engines:—

(*a*) Type of locomotive.
(*b*) Steam or petrol driven.
(*c*) Name or number of locomotive.
(*d*) Owner's name and address.
(*e*) Maker of locomotive.
(*f*) Date on which locomotive was built.
(*g*) Gauge of railway.
(*h*) Maximum height ft. in., and width ft. in. of locomotive.
(*i*) Work (if any) on which locomotive employed.
(*j*) Weight and general description.

and to make such further returns concerning any such engine or engines as may hereafter be required by the Deputy Director-General of Railway Material Licences.

German Litigation in War-time!—A remarkable instance of German audacity in commercial matters towards an enemy country is reported from Germany, where, notwithstanding war loans, money is comparatively scarce, except in privileged industries. This probably explains why the Accumulatoren Fabrik, A.G., of Berlin, has brought an action, as is announced in a Frankfort newspaper, against the Società Generale Italiana Accumulatori Elettrici, of Milan, for the fulfilment of conditions embodied in a contract which was entered into between the two companies in 1907, relating to certain payments, and the free allotment of one-tenth of the amount of a new issue of shares. The plaintiff company is said to claim the payment of £31,000, together with interest at 5 per cent. as from March 31st, 1916, and the surrender of shares for £8,000 (200,000 lire), forming part of the new issue which was resolved upon at the general meeting of the Italian company held in August, 1916. A demand of this kind in war-time, and from one enemy country towards another, is beyond the comprehension of anyone—except a German.

Japan and Enemy Trade.—The Tientsin correspondent of the *Morning Post* states (under date December 27th) that the announcement that the Japanese Government will shortly promulgate strict enemy trading regulations has aroused much interest and satisfaction among the Allied communities in North China. A few days ago a Russian decree, forbidding all trade with enemy or blacklisted firms, was published in the Press. "In order to make the Allied action absolutely watertight it only remained for Japan to adopt similar measures. The Enemy Trading Regulations of France and Great Britain have undoubtedly caused the German firms and merchants in the Far East considerable difficulty and inconvenience. The Japanese authorities, although they have not up to the present fallen into line with their Allies in this matter, have always shown themselves willing to assist when the British or French Consulates could show that cargo intended for shipment by Japanese vessels was of enemy origin or destination. But owing to the German habit of employing Chinese 'fences,' it has often been extremely difficult to obtain such proof, and there is no doubt that there has been serious leakage in the economic coffer-dam of the Allies in the Far East. We may now expect all this to be changed. The onus of proving that suspect cargo is not of enemy ownership, origin, or destination, will now fall upon the Japanese shipping companies, and consequently the position of German commercial interests in the Far East ought to become much more uncomfortable."

After the War: Extracts from the Premier's Carnarvon Speech.—In his reference to the work done by the Ministry of Munitions—as a basis for an appeal against premature criticism of Mr. Neville Chamberlain and his National Service Department—Mr. Lloyd George said:—"I have had a good deal of experience of what men of this kind can do, the great business men of this country, when you call upon them. The Mayor was good enough to refer to my work as Minister of Munitions. The only credit I take is this—that I gathered together as fine a body of men of able experience as ever came together in any Government Department, as ever existed in this or any other land. I do not pretend I did the work. They did it. I encouraged them. I stood by them, and now and again I scolded them; but we all worked hard. . . . They had not been there a few weeks dealing with an undoubted shortage, an undoubted deficiency, together with lost opportunities—before we heard censure and criticising. . . . They took no notice of it. . . . They knew they were going to confound all these things, not by speech, but by accomplishment. . . . What happened? The great battle of the Somme came. These men had mobilised the whole of the engineering resources of the country. Old workshops grew to life, new workshops were set up—you could see them north and south, east and west, wherever you travelled—old machinery made the best of, new machinery manufactured here and also ordered in America—machinery that will revolutionise industry after the war—and new industries were set up where before the war we had been dependent entirely on Germany. New industries were created, and *we are not going to drop them after the war.*"

Summing up his appeal to the nation to help in every possible way in the coming effort, Mr. Lloyd George said:—"When the smoke of this great conflict has been dissolved in the atmosphere we breathe, there will reappear a new Britain. It will be the old country still, but it will be a new country. Its commerce will be new, its trade will be new, its industries will be new. There will be new conditions of life and of toil, for Capital and for Labour alike, and there will be new relations between both of them, and for ever. But there will be new ideas, there will be a new outlook, there will be a new character in the land. The men and women of this country will be burnt into fine building material for the new Britain in the fiery kilns of the war."

Exemption Applications.—At the Westminster Local Tribunal, the London County Council appealed for over 200 men employed in the tramways department. This department had been in consultation with the Advisory Committee, but disputed the decision arrived at. The Military Representative stated that the authorities had released a certain number of men on condition that the Council would give up a number of men at present certified. If they would not do that the Army must have the others. The L.C.C. Representative: We are almost at the end of our tether. If the tramways are of national importance, we must have the men. A Member: There are too many cars in the afternoon; they are often empty. Why cannot women drive cars? L.C.C. Representative: The police will not let them. The Tribunal allowed 150 men in certified occupations three months' exemption, with leave to apply again. Forty cases were withdrawn, and 30 men, 24 of whom were tram-drivers, were removed from the certified list.—*Morning Post.*

At Southport, the borough electrical engineer, Mr. A. S. Black, appealed for three employés at the electricity works. The Military Representative said the men had been badged, but they were now de-badged. The Chairman said Mr. Black had stated that if these men were taken he could not be responsible for the lighting of the town. The case was adjourned for Mr. Black's attendance.

A Southport appeal, heard at the County Appeals Tribunal, was that of A. Robertson Hunt (39), electrical engineer, of Ainsdale, who appealed against the decision of the Local Tribunal. The latter had refused his claim, but allowed time to the end of March. The appellant said that prior to the war he had business premises in Liverpool, but had since given them up, and he described the nature of his technical work. The Military Representative said he would be very useful in a technical corps in the Army. Exemption to April 1st was given, with no further appeal without leave.

The Shipley Electricity Committee applied at the Local Tribunal last week for three men engaged as boiler firemen, J. Swallow (37), G. Clow (35), and T. Pennington (34). Postponement was granted in each case till June 30th.

At Grantham, on January 26th, the Urban Electric Supply Co. appealed for five employés, viz.: T. H. Heritage (26), station superintendent fitter, conditional exemption to stand; J. H. Williams (26), shift engineer, conditional exemption withdrawn for substitution; A. W. Dyke (18), switchboard attendant, conditional exemption withdrawn for substitution.

An electrical engineer of Westcliff, appealing at Southend-on-Sea, said that he had been twice rejected, and was now placed in Class C 3. He felt that if employed where he could use his professional knowledge he would be of more service to his country, and he had applied for such work, including a post at Salonika. He was with the British Thomson-Houston Co., Ltd., of Upper Thames Street, E.C. The Tribunal extended appellant's exemption until March 1st.

The same Tribunal granted until June 1st to a medical electrician (29), wholly engaged at the Queen Mary Royal Naval Hospital at Southend.

At Nuneaton, an appeal was made by Percy H. Howe (28), electrical fitter, who is engaged on Government work. On the suggestion of the Advisory Committee, exemption until July 1st was granted on appellant not changing his avocation.

At Canterbury, on January 29th, Mr. E. J. Philpot, electrical engineer, appealed for two employés, S. Kingham (29), and A. S. Fassum (31). The last-named, he said, was responsible for the maintenance of a number of electrical installations in the district, including the Kent and Canterbury Hospital. He had two other electric wiremen, and was doing work for the military. Kingham was allowed three months, and Fassum was directed to join up on February 28th.

Dr. Watson, of the Alltymynydd Sanatorium, appealed to the Carmarthenshire Tribunal against refusal of exemption by the Local Tribunal to D. Williams, electric light attendant. The appeal was allowed, and conditional exemption granted.

A Brighton firm of electrical engineers appealed for their branch manager (32), three electrical fitters, aged respectively 30, 41, and 34, and an electrical clerk (27). The firm, which has branches at Eastbourne and Worthing, stated that they were doing considerable work for munition factories, hospitals, and the Royal Flying Corps. Four of the men were allowed three months each, and the other appeal was adjourned.

At Exeter, the city electrical engineer (Mr. Munro) supported an appeal by Messrs. Cory Bros., coal merchants, for exemption for J. Gregory (40), in Class B 2, on the ground that the man was indispensable to the undertaking for discharging coal from trucks at the works. Exemption until May 31st was allowed.

Worcester City Tribunal has granted conditional exemption to seven employés of the Tramway Co., all of whom are over 31 years of age; and allowed exemption until a substitute is found for another employé, aged 27.

At Salisbury, the Electric Light Co. were the respondents in a Military appeal against conditional exemption held by an assistant engineer, two engine drivers, and a meter tester. For the company, it was stated that 12 out of 23 men had been released for service, and one more was going. The men appealed against were in certified occupations, and their work required skilled men. One of the drivers, placed in Class B1, had been with the company for 17 years. One driver was allowed until March 1st, and the others until June 1st.

At Hastings, it was stated that the Military had assented to conditional exemption in the majority of the cases in which certificates of exemption held by employés of the Tramway Co. had been withdrawn. The general manager (Mr. Vincent Edwards) said that the majority of the men concerned were employed in the power-house and sub-stations, and they were doing their best to find substitutes for the younger men. At the present time they were employing several discharged soldiers, and trying to train them. He hoped that these would come in time to be suitable men. The Tribunal granted conditional exemption to all the tramway-men appealed for, and Mr. Edwards said that if the men could do public service they would.

At Reigate, on January 30th, the Military asked for the withdrawal of exemption certificates granted by the Recruiting Officer to nine men with the East Surrey Traction Co., Ltd., including Mr. A. H. Hawkins (34), manager and director. Mr. Hawkins asked the Tribunal to confirm the certificates granted to men who are in reserved occupations, but the Tribunal decided that the best course to pursue was to withdraw all the certificates and review the cases when they came up on their merits.

LEGAL.

Electric Heating Device.

An electric heating device was the subject of an application in the Patents Court, on Wednesday, last week, before the Controller-General, Mr. Temple Franks, sitting with Sir Cornelius Dalton.

Messrs. Benham & Sons, Ltd., of 66, Wigmore Street, W., manufacturers of electrical appliances, applied for licence to use the Patent 26,347, of 1912, in the name of Martin Albrecht, of Gunthernburgalle 100, Frankfurt-a-Main, Germany.

This patent claims electric heating devices or bodies of the kind in which the resistance, suitably insulated, is placed in a metal casing.

The method consists of strongly pressing a thin metal casing around a resistance strip in such a way that the heat produced in the resistance strip by the electric current will be transmitted almost instantly to the wall of the casing.

The resistance strips are packed, as usual, between thin mica plates, whereupon the resistance strip, insulated by the mica plates and inserted in a tube having comparatively very thin walls and circular, oval, or, preferably, rectangular in cross-section, is rolled or compressed, so that the walls of the tube will be pressed or rolled with considerable pressure upon the mica plates. To prevent the walls from buckling or yielding and drawing apart, the tube may, in being pressed, be formed with lateral collars or flanges.

The process enables heating strips to be produced with a heating capacity of from 10 to 50 watts per sq. cm. of their surface. They transmit almost instantly the total heat to the liquid.

For the applicants, Mr. Bousfield (of the firm of G. F. Redfern and Co., patent agents) said the applicants had made a speciality of electrical kitchen appliances and such apparatus for use in hospitals. One of these was an apparatus for heating water. The apparatus referred to in this letters patent, while it had its distinctive features, was after a well-known type. Messrs. & Benham Sons, Ltd., had applied for letters patent for this device, but they found in front of them the patent which they now asked for licence to adopt.

The Controller inquired whether the apparatus could be used for cooking purposes?

Mr. Bousfield replied that its main purpose was for heating water. It might, however, be made in any size. The efficiency was said to be, at any rate, 95 per cent.

Applicants' assistant manager, Mr. Charles Reed Allansby, explained that previously they had made electrical heating appliances by attaching the heating element to the base of the vessel on the outside. Now they desired to immerse the element in the water. They might eventually make specially constructed kettles, with a grooved receptacle for the element, and then water could be boiled without an exterior fire or appliance. They wished to put the apparatus they now had in hand upon the market at once, and would be ready to pay a royalty of 5 per cent. to the end of the war. They anticipated a public demand, and they proposed to employ the method in apparatus they were making for their own use. The article would be made in various sizes. It would be useful for the sterilising vessels surgeons used for their instruments when carrying out operations. The element would be smaller in that case.

The Controller said he saw no reason why the royalty of 5 per cent. should not be accepted as fair, and the Court would recommend that a licence be granted by the Board of Trade.

Fowler *v.* Midland Electric Corporation for Power Distribution, Ltd.

In the Chancery Division, on February 1st, Mr. Justice Eve reserved judgment in an action against this company, of Birmingham, by Mr. G. W. Fowler, of Old Dean Hall, Camberley, executor of the estate of his late aunt, Miss M. J. Fowler. He claimed payment of £1,800, the value of 18 debentures of £100 each, a premium of £45, and interest at the rate of 4½ per cent. from June 30th, 1913, the date when the debentures matured.

The case for the plaintiff was that after the death of his aunt, the company sent her notices of the expiration of the series of debentures of which hers formed a part, and of the issue of a new series. These, of course, she did not receive, and the plaintiff claimed that interest on the debentures continued to run until they were paid off; the company first declined to pay any interest from June 30th, but afterwards they said they were willing to pay the income on the money set aside for the payment of the debentures. He also contended that it was the duty of the company to find their creditor within the realm, the debentures not being payable at any particular place. There was an executor who could give a proper discharge for the money.

For the company it was argued that the plaintiff had been in default in not doing certain things which would have put the company in possession of the knowledge they required, that he was responsible for what had happened, and that that was a good reason why no further interest should be paid. The debentures were in the common form in not having any place specified where payment should be made, and it was no part of the company's duty to

send people wandering through the land in order to make legal tender of money due to debenture-holders who did not choose to apply for payment in the usual way. If the plaintiff's contention was upheld, it would mean that in the future debentures would have to be framed in a very different way.

His Lordship, in saying that he would give judgment in a few days, remarked that the case was one that would affect many others.

De'Ath *v.* London Electric Railways Co.

At the Surveyors' Institution, Westminster, Mr. Samuel Walker, F.S.I., as Arbitrator, heard a claim for compensation by Mrs. Phoebe De'Ath against the London Electric Railways Co. for damage alleged to be caused by noise from the Bakerloo Extension Tube Railway to her property, 38, Randolph Gardens, Kilburn.

Mr. D. N. McNaughton was counsel for the claimant, while Mr. Eustace Hills appeared for the railway company.

Mr. McNaughton said the complainant complained of the noise and vibration immediately after the railway was opened in January, 1915. A few months later her solicitor made a claim, but, at the request of the company, the matter stood over until January, 1916, when liability was disputed. An Act of Parliament met the nuisance of noise, which, according to the claimant's case, was greatest in the early morning and from 6 to 10 o'clock at night.

Mr. O. De'Ath, husband of claimant, said that when the tube was opened, one of the tenants communicated with him in reference to the noise, and Witness wrote to the company.

Mr. and Mrs. Charles Poynton, tenants of the ground floor since 1911, said a rumbling noise, something like thunder, was made by the trains every day. It varied a great deal, but they heard it more in wet weather.

Mr. J. J. Done, surveyor, said that one evening when he visited the property he noted that 10 trains passed in 15 minutes. The noise they made sounded like thunder as heard in the distance, and it gradually increased and then decreased. Four of the trains were particularly heavy and extremely noisy. On making a test he came to the conclusion that there was not much vibration, but the noise would have an effect on the value of the property, as it would put people off taking the flats, and anyone suffering from influenza would feel especially upset. He valued the property at £900, and came to the conclusion that one-third of the value would disappear sooner or later. He therefore put the compensation at £300. He went to the house three times, and could hear the noise on the top floor, but he had never been able to hear the L. & N.W.R. trains. In his opinion, depreciation would arise when it became necessary to find a new tenant. In future the owner might have a difficulty in letting the property. The market value of the claimant's interest was affected by the noise, as a purchaser would make due allowance on that score.

Mr. H. G. Beard, surveyor and auctioneer, estimated the depreciation in value at £336. On one occasion he counted 11 trains in 15 minutes. In his view, the rents would fall when the old tenants left.

Mr. Eustace Hills, on behalf of the London Electric Railways Co., argued that the noise was negligible, and that, as no damage had occurred for two years, claimant was not entitled to compensation. The L. & N.W. Railway was over 300 yards away, and there were several streets of houses between that railway and the property in question.

Mr. J. G. Head, surveyor and auctioneer, gave evidence on behalf of the Electric Railways. He said he visited the premises on two occasions, and heard the sound of trains, but it would need careful discrimination to say whence the sounds proceeded. He could distinguish the rumbling of trains at intervals of two minutes, but it was very slight, and there were other sounds. For instance, he heard the L. & N.W.R. trains, and the general traffic, and when this occurred the noise of the tube trains was swallowed up. There was nothing which depreciated the value of the property; the noise he heard was not sufficient to make any practical difference in the value. There were these noises all over London, and one got used to them; and his experience in places where houses had been much more severely affected showed that no difference had been made in the value.

Mr. J. Bate, surveyor, of Kilburn, also considered there was no depreciation. He had to listen attentively for the rumbling sound of trains. The facilities of the railway should tend to increase, rather than depreciate, the value of the property.

The Arbitrator, who reserved his decision, has now announced that he finds there is no damage.

Woolley *v.* Watson, Marsh & Co., Ltd.

At the Lambeth County Court, on the 1st inst., Judge Parry had again before him the case of Thomas Woolley, an electrician, who was being paid compensation for injuries received during his employment, at the rate of 15s. a week, under the Workmen's Compensation Act, the respondents being Watson, Marsh & Co. (Brondesbury), Ltd. The facts have previously been reported in this journal, when the case came before the Judge in December, when, acting on the advice of the Medical Referee, he directed that 15s. a week should be paid to the applicant until the date of the present hearing, and that he should in the meantime endeavour to get back to work.

Mr. Kingsbury, for the respondents, reminded the Judge that he urged the applicant to go to work, even though it caused him a little pain. Some correspondence had since passed between the parties, and he should object to any further evidence being given on his behalf by his doctor, who he understood was present in court, as the doctors for the respondents were not present, and the case was last heard before the Medical Referee sitting with the Judge. He understood that applicant had been at work for some days, but feeling some pain, he had stopped. He (Mr. Kingsbury) thought he was capable of performing light work.

Mr. Bloxham, for applicant, said he tried to get light work, and in January was engaged at the Bon Marché, Brixton, packing china, his wages being 5s. a day, or 30s. a week. He stayed there four days, but his leg became so painful that he had to stop work, and had done none since. He had seen his panel doctor, who said the man was unable to work at present. Considering the light employment he had taken up at Brixton, applicant was getting very good wages, and would have stayed if he could.

Judge Parry said the difficulty was what to do in a case of this kind. It was one of those cases in which the man should persevere, even if he had a certain amount of pain at the outset, for, unless he did, the leg would get worse.

Mr. Bloxham said that probably applicant was one of those men who, when they felt pain, did not care to go on.

Judge Parry, after ascertaining that the applicant was 56 years of age, said that the Medical Referee, at the last hearing, said there were some effects of the injury still remaining, and that there was a certain amount of incapacity even yet from the accident. Whilst this litigation was hanging about he did not think the man would try to overcome his difficulties, and suggested that counsel should confer with a view to a settlement.

Counsel adopted his Honour's suggestion, and, after a short conference, announced that they had come to terms, which were to pay applicant 15s. a week up to date, and £25 in settlement of his claim.

Judge Parry said it was an excellent settlement for both parties. The Medical Referee before seemed to think that if applicant made a special effort he would be able to do some work of a light nature. Now was a splendid opportunity for him to do something, considering the condition of the labour market. He entered judgment for applicant for £25 in settlement of all claims in respect to this accident, with costs, but declined to allow the doctor's fee for attendance that day.

Coal Mines Act Prosecutions.

Contraventions of the Coal Mines Act were admitted by William A. McIlvena and John Bond, the manager and electrician respectively of Shettleston No. 2 Pit, at Glasgow Sheriff Summary Court. The respondents were charged with failing, between August 17th and October 6th, to have an armoured, non-flexible cable in connection with an electric pump in the Upper Kiltongue Seam of the pit securely attached to a switch-box, and failing to have a properly-constructed bush at the point where the cable entered the switch-box. Bond was charged, further, with failure to keep his log-book in the statutory form. An agent, on behalf of Bond, explained that the proper apparatus for the cable was ordered in August, but did not reach the pit until October. In consequence, Bond was a victim of circumstances over which he had no control.

Mr. J. D. Strathern, depute fiscal, said the regulations upon which the prosecution was founded were framed for the safety of coal mines, and must be strictly enforced. The security of the armouring in question was necessary to protect the insulated covering of the cable from being punctured, and thus allowing electricity to escape. The bush was also essential to prevent such a puncture. In the absence of these safeguards the insulating material of the cable had been punctured, and electricity escaped to the outside covering of a switch-box, and through that to the covering of the flexible cable which workmen had to handle. In consequence, in September last, a man was electrocuted at his work in connection with the pump in question. Both the respondents, he contended, had a heavy responsibility in the matter.

Sheriff Scott Moncrieff imposed a penalty of £5 on McIlvena and of £3 on Bond, the alternative in each case being seven days' imprisonment.

Helical Rollers, Ltd., *v.* Lockwood.

This action, by which the plaintiffs claimed specific performance of an agreement by the defendant to purchase certain patent rights and machinery, including two transformers, came before Mr. Justice Peterson, in the Chancery Division, upon a motion for judgment in default of defence and appearance.

Mr. Sheldon, who appeared for the plaintiffs, said that the agreement, which was contained in letters which were fully set out in the statement of claim, was an agreement that the plaintiffs should sell, and the defendant should purchase, for £200, two patents, two completed machines, and two partly-completed machines, together with the parts of such machines and two transformers. In January, 1916, the defendant wrote that it would be impossible for him to give more than £200, and on March 2nd he wrote that he was prepared to stand by his offer of January, and would be glad to know if it was accepted. On March 8th, the solicitor to the plaintiff company wrote that they were prepared to accept £200 for the patent rights, the two machines, and the two partly-completed machines, and that as they were giving up the lease of their premises on March 25th, they requested the defendant to come to Sheffield and arrange for the removal of the goods. The defendant did not complete the purchase though the plaintiffs had always been ready and willing to carry out their part of the agreement, and they had been compelled to store the machinery, incurring the cost of the rent for such storage

His Lordship said the defendant offered to purchase two

machines and two transformers, but he did not see how they came within the agreement.

Mr. Sheldon said he was instructed that they did. They were part of the machines, and were required for the working.

The defendant was not represented, and his Lordship made an order for specific performance, as asked.

Postmaster-General *v.* P. E. Schweder & Co.

In the City of London Court, on Tuesday, the Postmaster-General made a claim against defendants, stock and share brokers, 28, Throgmorton Street, E.C., to recover £5 18s., being £2 7s. 6d. telephone rent and £3 10s. 6d. for the loss of a standard receiver. The £2 7s. 6d. was paid into Court.

Mr. Alsop, for the Postmaster-General, said the defendants had a private wire from one of their offices to Sir Julius Weil's office. When the office was given up, the telephone apparatus had disappeared.

Mr. Schweder said before the war they were probably the largest users of private and other telephones in the United Kingdom. They had private wires to Liverpool, Birmingham, Manchester, &c., and during five years paid £26,000 in rentals for telephones. Telephone operators came in and out of their office at all hours of the day and night, with and without permission, doing work, and, in his view, the telephone in dispute must have been taken away—of course, not dishonestly—by one of the Postmaster's servants. He was only defending the action on principle. Although their business was closed by the order of H.M. Treasury, H.M.'s Post Office still made them pay rentals for telephones, and the landlords still required payment of rent. They had taken every care of the telephone apparatus on their premises.

Mr. Alsop said all he had to show was that the standard in question had not been returned, and that he claimed he had proved.

Judge Atherley-Jones, K.C., said it was not his place to sympathise with unfortunate renters of telephones, for he was a telephone renter himself in several places, but he thought the instrument in question had been taken away by inadvertence by H.M. Post Office servants; therefore judgment would be given for the defendants.

BUSINESS NOTES.

Aluminium Developments in France.—It is proposed to increase the share capital of the Electro-Métallurgique Francaise of Froges from £620,000 to £1,000,000 by the issue of new shares, which will be subscribed by the Compagnie Générale d'Electricité, the Electro-Métallurgie of Dives, the Compagnie Francaise des Métaux, the Tréfileries du Havre, and the firm of Giros & Co. As the transaction will be effected at a premium, the new issue of shares will yield over £800,000, which will permit of considerable extensions being carried out at the works at Froges, and will assure to the company valuable customers in the form of the companies participating in the issue. It is considered that the scheme will at last enable the rolling of aluminium to be expanded to the extent which it deserves, and under the auspices of this new industrial organisation.

A Register of British Manufacturers.—Thirty-five Chambers of Commerce of the United Kingdom have agreed to co-operate in producing an official register of all British manufacturers, with a view to wresting trade from the enemy. The register will be printed in five languages—English, French, Russian, Italian, and Spanish—and will be widely distributed amongst Ambassadors, Consuls, and Colonial and foreign Chambers of Commerce, and a carefully-selected list of traders in neutral countries.—*Morning Post.*

Catalogues and Lists.—British Thomson-Houston Co., Ltd., Rugby.—List No. 5,521, describing their pressure governor panels for A.C. or D.C. circuits.

Messrs. T. W. Broadbent, Ltd., Victoria Electrical Works, East Parade, Huddersfield.—Catalogue No. 5 (leaflet No. 4), of eight pages, containing an illustrated description of their type T three-phase alternating-current generator, with tabulated prices, sizes, weights and dimensions. The machines are provided with specially large exciters, so as to have a sufficient margin of continuous current available for lighting purposes; the three-phase current is for power transmission only. Copies of the list will be sent on application.

The British Thomson-Houston Co., Ltd., of 77, Upper Thames Street, London, E.C., have issued two effective show-sheets in colours. One, in which an automobile with brilliant headlights is the main feature, is designed to popularise Mazda drawn-wire lamps for motor-car use. The other—a larger sheet—assures the public that Mazdas are lamps that can be depended upon. Both show-sheets emphasise the British manufacture of the lamps. Copies may be obtained by contractors and other trade customers on application.

The Key Engineering Co., Ltd., of 4, Queen Victoria Street, E.C., have issued a vest-pocket celluloid calendar card for 1917.

Cambridge Scientific Instrument Co., Ltd., Cambridge.—List No. 196, describing and illustrating their resistance pyrometers for indicating and recording temperatures from 200° to 1,200° C. An inset chart gives the hot-blast temperature record obtained in a large ironworks.

Liquidations.—Immisch Launch and Boat Co., Ltd.—Creditors must send particulars of debts, &c., to the liquidator (Mr. T. H. Underhill, 75, Durham Road, Manor Park, London), by March 5th.

New Superheater Co., Ltd.—A meeting is called for March 6th, at Salisbury House, E.C., to hear an account of the winding-up from the liquidator, Mr. S. G. Bruff.

R.E.T. Construction Co., Ltd.—A meeting of creditors will be held at the Institute of Chartered Accountants, Moorgate Place, E.C., on February 12th.

Atlas Electrical Co., Ltd.—A meeting is called for March 5th, at 119, Finsbury Pavement, E.C., to hear an account of the winding-up from the liquidator, Mr. G. E. Corfield.

French Trade with South Africa.—A representative of a syndicate of French firms especially interested in the electrical and mechanical trades has been visiting South Africa in order to investigate on the spot what steps, if any, can be taken to improve trading relations between South Africa and France after the war. It is stated that the object of the syndicate is not to replace British goods in a British Colony by French goods, but to endeavour to obtain for French firms orders for goods which Great Britain and her Colonies cannot supply, and which, heretofore, have been given to German firms. It was thought that South Africa might find in France a market for copper, iron, asbestos, &c. The representative stated that it was probable that the syndicate he represented would establish branches in South Africa where stocks could be carried. Further, it was hoped to establish a line of steamers between France and Africa to take the place of the German East Africa Line. It was also suggested that an exhibition of French goods should be held in South Africa after the war.—*Board of Trade Journal.*

Machine Tool and Engineering Association, Ltd.—The annual meeting of this Association is to be held at Westminster, on Wednesday next. The report for 1916 shows that 24 firms have joined, and the membership is now 157. The financial position is satisfactory. The Association has continued to render assistance to the Ministry of Munitions. Five gentlemen had served on a Committee to advise the Controlled Establishments Section of the Ministry on questions of depreciation, allowance for additional output, &c., in so far as they affected the machine tool trade. Evidence was given before the Board of Trade Committee respecting engineering trade after the war. Suggestions have been made in a report presented to the Committee respecting steps that will be necessary on the part of the Government to assist in further developments of the trade. "A variety of Associations have been formed for the purpose of development of British trade after the war, but up to the present your directors have not seen their way to give support to any of these organisations. The Association directors hope at an early date to make representations to members concerning the prevention of the advertising of German goods after the war in British trade and technical journals."

Trade Announcements.—Messrs. Austin Walters and Son, of Manchester, have a well-equipped department for the manufacture of sheet-metal goods, such as large conical shades, resistance and circuit-breaker covers, and general sheet-metal work for electrical and ventilating engineers.

The premises of Messrs. Booth & Bomford, in Frederick Street, Cardiff, were involved in the fire which occurred there on January 29th. The firm's stock, tools, and fixtures were lost, but the books and papers were saved. Offices have temporarily been taken and business resumed at 9, Queen Street, Cardiff.

Electrical Imports of Uruguay.—According to a recent return, the imports of electrical goods into Uruguay during 1915 only attained a value of £46,140.

L.C.C. Contract Conditions.—The Highways Committee of the L.C.C. recommends in connection with the contracts with the British Westinghouse Electric and Manufacturing Co. and Ferguson, Pailin & Co., Ltd., for alterations and additions to switchgear at the Greenwich generating station, that the payments clauses to be inserted be as follows:—80 per cent. of the value of the machinery from time delivered, or of work executed on the site, 10 per cent. one month after the machinery has been taken over, and 10 per cent. after the expiration of the period of maintenance.

Book Notices.—*The Central* for December contains articles on "The Heat Treatment of Tool Steel," by C. W. J. Taffs; "The Value of a Training in Science in Industrial Work," by Dr. E. F. Armstrong; and "Machine Tools," by G. W. Tripp, as well as Old Student Notes, Reviews, &c.

"*Proceedings* of the Municipal Tramways Association (Incorporated), 1915-16." From the Association: Price 5s.

"Primary Batteries" (new and enlarged edition). By W. R. Cooper. London: *Electrician* Printing and Publishing Co., Ltd. Price 12s. 6d. net.

"Annales des Postes, Télégraphes, et Téléphones." Vol. V, Part 4. December, 1916. Paris: A. Dumas. Price 10 fr.

"Post Office Electrical Engineers' Journal." Vol. IX, Part 4. January, 1917. London: H. Alabaster, Gatehouse & Co. Price 1s. net.

"High-Speed Internal Combustion Engines." By A. W. Judge. London: Whittaker & Co. Price 15s. net.

The Faraday House Journal for the Lent Term contains a note on transmission of power between two A.C. power stations, by L. Romero, an abstract of Dr. Russell's Kelvin Lecture, and many additions to the Roll of Honour of past and present Faradians, as well as other items relating to the pupils of the College, &c.

LIGHTING AND POWER NOTES.

Australia.—The extension of the electric lighting system along the Milson's point line (Sydney North shore) is making substantial progress. The manager of the Sydney E.L. Department states that the supply should be available near the railway stations at Roseville, Lindfield, Killara and Gordon by the end of March or the beginning of April next.

The Sydney Council has decided to give a supply of electricity to the Paramatta Electricity Co.

The electrical engineer is to submit a scheme for providing coal storage in the vicinity of the Council's power house at Sydney.

The Shire of Rylstone, N.S.W., has applied for authority to install an electric lighting and power scheme.

Barrow. — Proposed Extensions. — The T.C. has approved the Electricity Committee's recommendation to extend the electricity works at a total estimated cost of about £25,800.

Bath.—The engineer has drawn attention to the maximum load of 1,318 kw. on December 18th last, with severe lighting restrictions in force, and in view of the probable shortage of plant when conditions become normal, he has been instructed to report on the situation.

Bedford.—The R.D.C. has given its consent to the use of overhead lines in the district by the T.C. for the transmission of energy to a new factory in the rural area.

Continental.—Spain.—According to recently-compiled statistics, the hydro-electric energy represented in the watercourses of Spain amounts to over 5,000,000 h.p. There are at the present time 110 large hydro-electric installations which utilise a total of 281,490 h.p., and a number of small plants which utilise 300,000 h.p., these figures would probably be increased by the end of last year to 500,000 h.p., several important generating plants having been in course of construction. The power reserved to the 110 large installations is 1,020,790 h.p., leaving 739,300 h.p. unappropriated. Numerous concerns utilise water directly as motive power without transforming it into electricity. In Catalona, the weaving industry utilises about 200,000 h.p., half of which is utilised directly. The rivers which flow from the Pyrenees and traverse Catalona aggregate 1,135,000 h.p., but the concessions granted account for only 800,000 h.p. The power furnished by Spanish rivers is shown as follows :—Ebro and its feeders, 1,300,000 h.p. ; Duero, 900,000 h.p. ; Guadalquiver, 750,000 h.p. ; Tagus, 700,000 h.p. ; Guadiano, 370,000 h.p. ; Mino, 250,000 h.p. ; Jucer, 190,000 h.p. ; Segura and feeders, 100,000 h.p. ; other rivers, 600,000 h.p. ; or a total of 5,160,000 h.p. These figures are suggestive of the opening for electric plant which the industrial progress of Spain offers.—*L'Ingegneria Ferroviaria.*

La Federacion Patronal de Industrias Electricas is the name of a new concern which has lately been organised in Barcelona, with a capital of £10,000, to develop electric lighting and power installations in Spain.

Norway.—The municipal electric sub-station in Hausmansgata, Christiania, is to be rebuilt, at a cost of 381,000 kroner.

The Divisional authorities of Bolne have decided to raise a loan of 150,000 kroner, with a view to the construction of a communal electricity works, Governmental approval of the scheme having been secured.

The Kvinnherred Divisional Council has approved a concession to the Aktie Selskab Mauranger for the development of the Mauranger Waterfalls. Some 100,000 h.p. is to be secured.

Large extensions of the Stavanger Elektro-Staalverk are planned, it having been decided to double the production, and work up all steel into finished goods. A rolling mill is to be built, and electric driving is to be extended, so as to exclude the use of coal.

Approval has been given to the local authorities of Gjerstad and Bremanger, Norway, to raise loans to develop water power for electrical industries in those localities for lighting and electro-chemical industries. The communal administration of Jevnaker, Lunner, Gran and Grandbu has appropriated $134,000 to enlarge the Hadeland electric station. The Bremanger Power Co. will erect a factory for producing carbide and cyanamide, producing 30,000 tons of carbide per year, of which one-third will be used for making cyanamide. A French-American syndicate is considering the erection of a large electrochemical plant in the Telemarken district, using 100,000 h.p. from the Maar Falls in Tinn.—*M. and C. Engineering.*

Cork.—It is expected that electricity will be the lighting medium in connection with the scheme for artisans' dwellings, necessitated by the industrial developments on the Cork Park and Marino sites, where motor and engineering works are to be started. The Corporation is taking steps to obtain a Government grant.

Dover.—Loan Sanction.—On account of the additional expenses (£1,300) caused by war conditions, the Government has contributed £500 towards the cost of a new cable ; it has also lent £3,814 to the T.C. to cover the cost of the cable, the interest payable being ½ per cent. over the current interest of the Government loan for the time being, with a minimum of 5 per cent.

Dublin.—At a meeting of the Dublin Corporation, on Monday, a letter was read from Mr. M. Ruddle, city electrical engineer, expressing surprise that a recommendation to supersede him by the creation of a new and, in his opinion, unnecessary, post, should have been brought forward without any opportunity being taken by the Special Committee investigating the administration of the electrical department to ascertain his views, as chief executive officer, of either the expediency or the necessity of such a proposal. His record of service during the 26 years he had had charge of the department should entitle his opinion to have some value. He did not know with what powers it might be proposed to endow Mr. D'Alton, but he did know that if given equal powers, his more intimate knowledge of the department would enable him to secure better results than that gentleman, as a stranger, could hope to achieve. Having spent the best years of his life in the service of his native city, Mr. Ruddle hoped the Council would recognise that he had first claim on any additional powers that might be given. The Council decided to refer the letter to the Special Committee.

Horsham.—Price Increase.—The Lighting Committee of the U.D.C. reports that it has under consideration the desirability of abolishing the maximum demand system, and adopting instead flat rates ; and that in view of the heavy deficiency which will result on the working of the electric light undertaking during the war, it has no alternative but to increase the price of energy as from March 31st next.

Liverpool.—Rate Relief.—The Tramways and Electric Power and Lighting Committee has decided to recommend a contribution towards the relief of the rates of £65,000 from the profits of the electric lighting department for the past year.

London.—Shoreditch.—With reference to our note last week regarding proposed extensions, it is intended to install a 5,000-kw. turbo-alternator at Whiston Street station, together with 11,000-volt, three-phase switchgear, also rotary converters at Coronet Street station, and two three-core ·25 cables to connect up the two stations, the total cost being estimated at £40,950.

L.C.C.—The Finance Committee recommends the sanction of the Council to the borrowing of £23,152 by the Woolwich B.C., for electricity purposes (turbo-alternator, £11,935 ; switchgear, £1,017 ; mains, &c., £10,200).

Manchester.—The Corporation has arranged that skilled men in the electricity department shall receive a minimum war allowance of 6s. 6d. a week.

New Zealand.—The poll of the Christchurch City Council on the proposal to raise £60,000 to extend the Council's electricity scheme, resulted in its favour.

The Tuakau (N.Z.) Road Board has decided to proceed with its electric lighting scheme and other works, for which a loan of £12,000 was recently sanctioned.

Nuneaton.—Proposed Loan.—The T.C. has applied to the L.G.B. for a loan of £1,950 for the provision of a new boiler and feed pump for the electricity works.

Rochdale.—Last week was one of much difficulty in connection with the electricity undertaking, and on Thursday and Friday last many consumers of power had their day supply cut off. Owing to the dearth of men to keep the boilers free of ashes, three out of the six boilers were out of use. During the week a quarter of the spinning department of the D.R. mills were run on a night shift, by arrangement with the Electricity Committee, so as to relieve the day load. Considerable criticism has been made, but it is stated that the Committee has been unable to secure delivery of the necessary ash plant. The tramway service was also affected to some extent.

Sunderland.—Year's Estimates.—The estimates for the year ending March 31st next were presented to a meeting of the Electricity and Lighting Committee on the 1st inst. The statement showed an output of 15,403,354 units, as against an actual output of 15,036,376 in the preceding year. The balance to be carried to the net revenue account was £31,462, slightly more than £800 above the actual balance for the preceding year. Of this sum, £28,309 would be absorbed by repayment of loans and interest ; contribution to capital was put at £1,137 ; income-tax, £2,241 ; and the renewals fund, £870. These appropriations would exceed the amount brought forward by some £1,095, which debit balance would be carried forward to the next year's account. Alderman Bruce said that the debit was due in part to increase in income-tax, in insurance, and in interest on loans, and employés' wages were a heavier item. He added that it was estimated that a loss of £1,063 had been occasioned solely through the bad quality of coal supplied to the department during the year.

Tasmania.—In regard to the proposal of the Launceston City Council to consider the question of additional steam plant, Mr. J. H. Butters, chief engineer and manager of the Government hydro-electric scheme, states there is no necessity to extend the Council's steam plant temporarily. If all the power mentioned in the Amalgamated Zinc Co.'s contract is actually taken by the company, this, together with other commitments, will absorb all that it is advisable to connect to the Great Lake scheme, but two years' notice must be given by the Zinc Co. of its requirements under the second block, and also any large industry which might be established at Launceston would probably require from 18 months to two years to erect its buildings and equipment. A consumer for a large block of power could at once enter into a contract, which, together with the existing Launceston load, would justify the erection of a line from the Great Lake, *viâ* Arthur's Lake, to Launceston. Then, in the event of the Amalgamated Zinc Co. ordering their second block, arrangements could be made to proceed with the Arthur's Lake scheme concurrently with an extension of the Great Lake scheme, and these two developments would be

completed at about the same time, when the Launceston load could be taken from Arthur's Lake and the Zinc Co.'s load from the Great Lake.—*Tenders.*

Tipperary.—Reporting to the Guardians, Mr. J. P. Tierney, consulting engineer, stated that the electricity plant at the workhouse buildings was totally inadequate; the battery had been completely overtaxed, and new plant would be necessary in the laundry.

Todmorden.—Proposed Turbine Plant.—The Corporation has approved a recommendation by the Electricity Committee that the existing generating plant is obsolete, and that a more economical plant should be installed, and has decided that steps be taken to install a 1,000-kw. turbo-generator, with all auxiliaries, at an estimated cost of £10,000, and that application be made to the L.G.B. for sanction to borrow this sum.

TRAMWAY and RAILWAY NOTES.

Accrington.—In accordance with an agreement between the two Corporations, the Blackburn and Accrington Corporation tramcars have commenced to run a through service.

Ashton-under-Lyne.—The Committee on Production has notified that the tramway bonus in the S.E. Lancashire area is to include increases in wages or bonuses granted since the war began.

Bacup.—Arbitration Award.—Mr. J. M. M'Elroy has issued his award in the arbitration betwen the Bacup and Rawtenstall Corporations, on the proposal of the latter to increase the number of stages on the Bacup-Rawtenstall tramway system. The result of the award is that there is no change in stages or fares, Bacup thus winning its case.

Blackburn.—Fare Increase.—The proposal to increase the fares and shorten the penny stages was agreed to by the T.C., an amendment to refer the matter back being defeated by a large majority.

The Corporation, on February 2nd, decided to adopt the award of higher wages for tramway workers; female employés will participate equally in the advance.

Bolton.—The Chief Industrial Commissioner has intimated to the Tramway Committee that the tramway bonus is to be proportionally reduced where time is lost, as in the case of wages.

Colne.—The T.C. has discontinued the 1½d. and 2½d. fares on the tramways, and withdrawn the books of discount tickets, owing to the advance in wages and other charges. Workmen's tickets are to be continued.

Continental.—Norway.—The authorities of Stavanger have unanimously decided to sanction the outlay of 1,275,000 kroner on the construction of an electric tramway in that city.

Darwen.—Fare Increase.—The Tramways Committee has to provide £1,240 a year for electricity, separation allowances, and increased wages over pre-war expenditure, and in order to meet these liabilities the Committee has decided to raise the fares.

Dundee.—The question of the use of electric haulage for jute and other goods was referred to by Mr. T. S. Dick at a city meeting. He estimated that the horse-haulage of a million tons of jute cost £13,541, whereas by electricity the work could be done for £4,464.

Glasgow.—At a meeting of the Tramways Committee, last week, it was announced that the system was now free from debt, all the capital expenditure of £3,835,156 having been repaid. The total of the sinking fund applied to the reduction of debt had been £1,506,267, and now the amount of the department's investments not only equals the balance, but there is a sum of £119,055 at the credit of the depreciation and permanent-way renewals fund.

Halifax.—Fare Increase.—The proposal of the Halifax Tramways Committee to effect material increases in tramway fares is arousing considerable opposition, both in Halifax itself and in surrounding townships which depend largely upon the Halifax tramway service. The Brighouse Corporation, last week, made comparisons between the Halifax and Bradford tramway services (both of which have some contact with the town), and the remarks were not entirely complimentary to Halifax. The Brighouse Council passed a unanimous resolution of protest against the Halifax Committee's proposal.

L. & Y. Electric Railway.—Owing to the failure of the electric current, there was a dislocation of passenger traffic on the Liverpool-Southport electric line on Monday. Practically all the trains were late, and they had to be hauled by steam locomotives.

Liverpool.—Rate Relief.—The Tramways and Electric Power and Lighting Committee has decided to recommend that £125,000 from the profits of the tramway department for the past year be allocated towards the relief of the rates.

London.—L.C.C.—The Highways Committee has appointed a Special Sub-Committee to consider what alterations should be made in connection with tramway services and fares and methods of collection of fares. The Committee has had under consideration the effect of the closing of certain railway stations and the increase in fares.

On the South Bermondsey and Old Kent Road routes additional trailer cars have been put into service during the busy periods of the day. On the Forest Hill and Dulwich services little can be done at present in the direction of providing additional accommodation. Owing to the shortage of drivers, which now exceeds 350, the service on any particular route can only be increased by reducing the services on others.

Additions are to be made to the condensing water system at the Greenwich power station, at a cost of £23,500, to enable the new turbo-generator plant to be fully used. A new agreement has been come to with the London Electric Supply Corporation for a give-and-take stand-by supply at the New Cross and Camberwell sub-stations, up to 3,000 kw.

The Highways Committee reports that the Court of Arbitration of the B. of T., on December 20th, awarded motormen, conductors, and other male employés of the traffic section a further war bonus of 3s. 6d. per week, or 7d. per day; the claim of the female employés was not established.

The Highways Committee has settled 1,175 claims against the Council during the three months ended December 31st last in respect of accidents in connection with the working of the Council's tramways, amounting to £8,747. In 26 other cases, action was brought against the Council; in 14, an adverse verdict was given, and £1,600 and costs had to be paid.

On Monday the Council's conduit tramway services were generally dislocated owing to the melting snow and salt getting into the conduits and causing short circuits. The cars ran spasmodically until 5 p.m., when the whole of the conduit sections were shut down, and many thousands of people were left stranded at the various termini. Those routes using the overhead trolley system were unaffected.

Sunderland.—Year's Estimates.—The estimates for the year ending March 31st next show a total income of £85,352, compared with the actual income for 1915-16 of £79,124. Working expenses are set down at £50,127, against £44,455. Traffic expenses show an increase of £2,500, largely due to the increased wages paid to employés. The estimated balance to be carried to the net revenue account, including bank interest, is £35,447. It is suggested to appropriate £5,000 in relief of the rates.

TELEGRAPH and TELEPHONE NOTES.

Italy.—Unlike the German Mercantile Marine before the war, many Italian and French merchantmen are unprovided with wireless installations. The Direction of the Italian Marine has taken the matter in hand, and, by a recent decree, prescribes that every ship carrying more than 50 persons must be provided with a wireless installation and a trained staff.—*L'Industrie Electrique.*

Telegrams by Telephone.—As the delivery of telegrams by messenger is becoming more and more difficult, the Postmaster-General has again drawn attention to the advantages of receiving by telephone telegrams directed to an abbreviated address. An appreciable saving of time results from this method of delivery. Any registrant who is willing to accept delivery of his telegrams by telephone should communicate in London, Dublin, and Edinburgh with the Secretary, and in the country with the postmaster of the town at which his address is registered, when the necessary instructions will be issued.

Telephone Deposits.—Private subscribers to the British telephone system are being asked to pay larger deposits on the message-rate system, owing to the accounts being sent out quarterly, instead of monthly, for the sake of economy in book-keeping.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—Feb. 19th. Municipal Council. Meters, maximum-demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

March 5th. Council. One 7,500-k.v.a. turbo-alternator. See "Official Notices" January 5th.

Adelaide.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd.

Melbourne.—February 14th. City Council. 699,000 arc lamp carbons. See "Official Notices" February 2nd.

March 21st. Victorian Railways. 200 Half-watt lamps and 100 lanterns; also 100 contact couplings.* April 4th. Terminal blocks (complete) for electrical connections.—*Australian Mining Standard.*

March 7th. Council. 1048 Electricity Recording Meters. See "Official Notices" to-day.

Brisbane.—March 28th. P.M.G.'s Department. Cable (switchboard), Schedule 394.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 K.V.A. capacity. See "Official Notices" to-day.

Cheltenham.—February 14th. Corporation. Twelve months' supply of electric light fittings. Mr. J. S. Pickering, Borough Engineer.

Halifax.—February 12th. Corporation Tramways Committee. Stores and materials, including lighting materials, wheel brake blocks, trolley and overhead line materials, &c., for twelve months. Tenders to Tramway Engineer.

Harrogate.—March 5th. Corporation. By-product steam boiler plant. See "Official Notices" February 2nd.

Keighley.—February 24th. Keighley and Bingley Joint Hospital Board. Electricians' work for 12 months. (See last issue.)

London.—L.C.C.—The Highways Committee recommends that tenders be invited for the supply of tramway fittings, equipment, &c., for alternative periods of six and twelve months in 1917-18.

BERMONDSEY.—February 22nd. B. of G. Three, six and twelve months' supply of electric lamps. Mr. E. Pitts Fenton, Clerk, 283, Tooley Street, S.E.

Manchester.—March 7th. Electricity Committee. Coal-conveying plant and suction ash plant. See "Official Notices" to-day.

Salford.—February 12th. Miscellaneous stores for Tramways Department. General Manager, 32, Blackfriars Street.

South Africa.—DURBAN.—February 12th. Six four-ton electric travelling portable jib-cranes for the harbour.*

March 8th. Department of Posts and Telegraphs. Installation of an automatic telephone exchange at Pietermaritzburg. See "Official Notices" January 19th.

Spain.—The municipal authorities of Tuy (Province of Pontevedra) have lately invited tenders for the concession for the electric lighting of the town during a period of 25 years. Tenders have also been invited by the municipal authorities of Elda (Province of Alicante) for a similar concession for only three years.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Australia.—MELBOURNE.—City Council. Accepted tenders :—

Two hundred 300-watt gas-filled metal-filament lamps, and six hundred 500-watt ditto.—Aust. General Electric Co., £540.

10,000 assorted metal-filament lamps.—British General Electric Co., £790.

Bolton.—The Corporation has accepted a tender for the supply of an electric tipping-wagon.

Leeds.—Electricity Committee. Recommended tenders :

Babcock & Wilcox, Ltd.—Two water-tube boilers and accessory plant for the new generating station, £12,959.

Wm. Airey & Son.—Foundations, £2,000.

London.—L.C.C.—The Highways Committee has accepted the following tenders :—

325 tons of rolled-steel bar for magnetic brake shoes, for the Tramways Department.—Frodingham Iron & Steel Co., Ltd.

Maintenance of the battery of 280 cells at the Greenwich generating station for a further period of 10 years, at £116 a year.—Tudor Accumulator Co., Ltd.

Supply of cotton-covered wire (tramways equipment 1916-17, Class T, 6a).—Items 1 and 4, London Electric Wire Co. & Smiths, Ltd. (approximate amount £691); items 2 and 3, B.I. & Helsby Cables, Ltd. (approximately £1,353); item 5, Midland Electric Wire Co., Ltd. (approximately £388).

The Highways Committee reports the purchase of 27,735 tons of coal for use at Greenwich generating station, at a cost of £44,166, during the quarter ended December 31st, 1916.

Manchester.—Electricity Committee. Accepted tenders :

Cable.—Western Electric Co., Ltd.; Pirelli-General Cable Works, Ltd.; C. Macintosh & Co., Ltd.; B.I. & Helsby Cables, Ltd.; W. T. Glover and Co., Ltd.; Liverpool Electric Cable Co., Ltd.; Callender's Cable and Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.

Stoker links.—Babcock & Wilcox, Ltd.

Steel air-ducts.—British Westinghouse E. & M. Co., Ltd.

Salford.—Electricity Committee. Tenders accepted :—

Equipping a blank switch cubicle at the Trafford sub-station, £102; supply of switch cubicle, £153.—British Westinghouse E. & M. Co., Ltd.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, February 9th. At 5 p.m. At the Imperial College of Science, South Kensington. Annual general meeting.

Salford Technical and Engineering Association.—Saturday, February 10th. At 7 p.m. At the Royal Technical Institute, Peel Street. Paper on "Modern Iron Foundry Practice," by Mr. W. Rawlinson.

North of England Institute of Mining and Mechanical Engineers.—Saturday, February 10th. At 2 p.m. At the Wood Memorial Hall, Newcastle-on-Tyne. Ordinary meeting.

Birmingham and District Electric Club.—Saturday, February 10th. At 7 p.m. At the Swan Hotel, New Street. Presidential address and smoking concert.

Chief Technical Assistants' Association.—Saturday, February 10th. At 3 p.m. At the Tavistock Hotel, Covent Garden, W.C. Adjourned discussion on "The General Principles in connection with the Lay-out of Power Stations."

Electro-Harmonic Society.—Monday, February 12th. At 6.15 p.m. At the Venetian Chamber, Holborn Restaurant. Concert (ladies' night).

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, February 13th. At 7 p.m. At the Engineers' Club. Paper on "Frequency Changers," by Mr. R. Townend.

(Newcastle Local Section).—Monday, February 12th. At 6.45 p.m. Discussion on "The Metric System," to be opened by Mr. G. Stoney.

(Scottish Local Section).—Friday, February 16th. At 7.30 p.m. At 207, Bath Street, Glasgow. Eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," by Dr. A. Russell.

Royal Institution of Great Britain.—Thursday, February 15th. At 3 p.m. Lecture on "The Mechanism of Chemical Change," by Prof. F. G. Donnan, F.R.S.

Belfast Association of Engineers.—Thursday, February 15th. At 7.45 p.m. At the Municipal Technical Institute, College Square. Paper on "Liquid Air," by Mr. E. A. S. Swinson.

Institution of Mechanical Engineers.—Friday, February 16th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Annual general meeting.

Greenock Electrical Society.—Saturday, February 17th. Visit to Dellingburn power station. (Members to meet at 2.30 p.m.)

Association of Mining Electrical Engineers.—Saturday, February 17th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Electrical Converters," by Mr. C. S. Buyers.

NOTES.

The Electro-Harmonic Society.—The next concert (ladies' night) will be held at the Holborn Restaurant, in the *Venetian Chamber*, on Monday evening next, February 12th, commencing at 6.15 p.m. The artistes will be as follows :—

Miss Maude Willby, soprano ; Miss Mabel Braine, contralto ; Mr. Allen Engles, bass-baritone ; Mr. Paul Brunet, violin ; Mr. Ben Lawes, humorist ; Miss Edith Eatherley, entertainer at the piano ; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

Appointments Vacant.—Installation inspector (45s.) and fireman used to chain-grate stokers (35s.), for the Southampton Corporation electricity department ; Diesel engine driver and switchboard attendant, for the Sale U.D.C. electricity works ; charge engineer (£120), for the Ilford U.D.C. electricity department.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters, Balderton Street, Oxford Street.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding :—

Monday, February 12th.—Technical for Platoon No. 8, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill. 6.30—8.

Wednesday, February 14th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 2.

Thursday, February 15th.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30.

Friday, February 16th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.30—8.30.

Saturday, February 17th.—Commanding Officer's Parade, 2.45. Uniform.

Sunday, February 18th.—Entrenching at Otford. Parade Victoria (S.E. & C. Railway Booking Office), 8.45 a.m.

(By order), MACLEOD YEARSLEY, *Adjutant*.

German Electrician Recaptured.—The *Times* states that at Marlborough Street Police Court, on January 31st, Emil Schmidt, 26, a German, described as an electrician, was sentenced to six months' imprisonment, with hard labour, for failing to comply with the registration regulations. Schmidt escaped from an internment camp on December 29th. On January 27th he was recognised by detectives in Wardour Street. He ran away, but was pursued, and captured in Leicester Square.

The Russian Language.—Birmingham Chamber of Commerce has raised £10,000 to endow a chair in Russian at the University, and a lecturer has been appointed to begin the work of the department.—*Times*.

Foreign Trade.—THE JANUARY FIGURES.—The official returns of imports and exports during last month contain the following electrical and machinery figures :—

	January, 1917.	*Increase or decrease.*
IMPORTS :—		
Electrical goods, &c. ...	£176,052	+ £57,150
Machinery	717,626	+ 16,808
EXPORTS :—		
Electrical goods, &c.... ...	371,084	+ 91,151
Machinery	1,988,261	+ 508,130

Tramways and Substitution.—With reference to the Note on this matter on page 97 of our issue of January 26th, the *Daily Chronicle* says that to meet the shortage of tramcar drivers the War Office will release from the Army motormen who are not in Class A, in exchange for other tramway workers up to 30 years old who are Class A men.

Engineers' Wages.—Representatives of the workmen engaged in the engineering and allied trades, together with delegates from the Employers' Federation, resumed their conference with Sir George Askwith at the Chief Industrial Commissioner's Department, Westminster, on Monday, when further consideration was given to the question of the method of procedure for dealing with wage applications. The Unions represented included the Amalgamated Society of Engineers, the Steam Engine Makers, Tool Makers, United Machine Workers, Electrical Trades' Union, Scientific Instrument Makers, Pattern Makers, Blast Workers, and General Workers' Union. The proceedings were private, but at the close Mr. Robert Young, secretary of the Amalgamated Society of Engineers, stated that as a result of the conference satisfactory conditions were agreed to for dealing with wages on a national basis.—*Morning Post.*

The Metric System.—The Executive Council of the U.D.C. Association on January 15th, at Palace Chambers, Westminster, passed the following resolution:—This Council hereby expresses itself in favour of the decimal system for coinage and the metric system for weights and measures, and advises members of the Association to support the efforts of the Decimal Association in bringing to a successful issue this desirable and much-needed reform.

Germany's After-the-War Trade Schemes.—In a series of Empire Trade Notes issued by the British Empire Producers' Organisation, there appears the following translation of a circular letter which, it is stated, has been posted extensively from an office in Havana:—

"Recently there has been formed in Germany a vast organisation, entitled 'The German Economic Federation for Central, South America, and the Antilles,' to foment export commerce when peace is declared. Its field of action will be on this side of the Atlantic, in all the Spanish-American countries.

"With it will be affiliated the undermentioned Associations already in existence, viz.:—

"Argentine-Germany;

"Brazil-Germany;

"The Hamburg Export Union; and

"The great German steamship companies.

"A newspaper will be published in Spanish and Portuguese to supply all information, scientific, banking and commercial, to the Spanish-American countries, and an annual publication which will give publicity to everything related to the commerce of those countries.

"In Berlin a club will be instituted to which we will admit all the business men and other travellers from the Americas.

"With peace will commence a great maritime activity. Germany is in the position of being able to place at once in active service her steamers, and will have the same tonnage at sea as before the war, even although she should not recover the steamers which are prisoners in enemy ports. The shipping constructed during the war is approximately equal to that which has been captured or destroyed.

"The annual subscription will be *ad libitum* from each subscriber, but not less than—

"Marks: 120 annual subscription from firms.

"Marks: 25 admittance fee from firms.

"Marks: 30 annual subscription from individuals.

"Marks: 10 admittance fee from individuals.

"I invite you to become a member of the Federation, and to that effect I permit myself to enclose a subscription form, begging you to return same with your remarks."

L.C.C. Electrical Workers' Wages.—The Highways Committee reports the award, dated December 29th, of the B. of T. Court of Arbitration to certain grades of employés of the rolling stock section of the Council's tramway department, the advances to date from November 6th.

The wages of engineering employés (excepting toolmakers employed on munition gauge work), millwrights, electricians, coach-body makers, wheelwrights, and mechanical and electrical repair staff at car sheds (excepting light and power attendants) to be advanced 3s. a week. Light and power attendants at car sheds, beltmen and oilers, armature winders, armature banders, magnet and coil winders, plough repairers, wiremen at central car repair depôt, &c., those receiving under 35s. a week to be advanced 4s. a week, and the wages of those receiving 35s. a week and over to be advanced 3s. a week. Women at the central car repair depôt to be advanced 2s. a week.

The Court commends to the favourable consideration of the Council the case of women under 21 years of age who are engaged at the repair depôt, and who are doing women's work.

From January 29th, 1917, the hours of the electrical and repair staff at car sheds (except light and power attendants) employed on night shifts to be reduced from 10 hours to 9 hours, the men to be paid the same amount as if working 10 hours; if at the end of four calendar months the Council finds that the reduction of hours is not reasonably satisfactory, the Council may alter the number of hours from 9 to 10, or to any other period of time between 9 hours and 10 hours (the same amount of pay being continued).

The award to the electrical section is as follows:—

Charge engineers at sub-stations to receive a war bonus of 2s. 6d. a week. Shift workers and certain other employés at Greenwich generating station, men earning under 43s. a week to receive a further war bonus of 3s. 6d. a week, those earning 43s. up to and including 50s. a week to receive a war bonus of 3s. a week, and those earning over 50s. a week to receive a war bonus of 2s. 6d. a week.

Light and power attendants employed in the permanent-way section of the tramway department receiving under 35s. a week to be advanced 4s. per week; 35s. and under 43s., 3s. 6d. a week; 43s. and over, 3s. a week.

The whole of the advances to be regarded as war wages.

Excess Profits Duty.—The Thermo-Electric Ore Reduction Corporation, Ltd., of York Street, Luton, made application to the Commissioners of Inland Revenue for an increase of the statutory percentage as respects the "business of manufacturing and preparing tungsten, molybdenum, chromium, tantalum, vanadium, and their alloys, so far as the same are used in the manufacture of high-speed steel." The Commissioners having referred the case to the Board of Referees, have ordered that the statutory percentage shall be increased to 12 per cent. in the case of a trade or business carried on or owned by a company or other body corporate, and to 13 per cent. in the case of any other trade or business.

Standard Battery Jars for Electrical Vehicles.—At the recent meeting of the American Society of Automobile Engineers, in New York, the recommendations of the Electric Vehicle Committee with regard to battery dimensions were adopted. Two heights of jars were recommended, one type, known as "high-rib" jars, having a sediment space of 2¾ in., and the other, styled "low-rib" jars, 1¾ in. The dimensions of each type of jar are all constant, except as regards the length, but the number of lengths has been considerably reduced from the total number at present in use. The dimensions proposed for high-rib jars are as follows:—

Height	13⅜ in.
Width	6¾ in.
Thickness of wall	⅛ in.
Height of rib	2¾ in.
Height above rib	10⅝ in.
Lengths	2 in.—8¼ in.

The dimensions for low-rib jars are as follows:—

Height	12 7/16 in.
Width	6⅛ in.
Thickness of wall	⅛ in.
Height of rib...	1¾ in.
Height above rib	10 7/16 in.
Lengths	2 in.—8 in.

Tolerances: + or − 1/32 in. for all dimensions except thickness. Jar walls 3/32 in. thick are optional, but when used all outside dimensions, including height, should be increased 1/16 in.

Alquist Gearing.—At the annual meeting of the Society of Naval Architects and Marine Engineers, U.S.A., Mr. W. L. R. Emmet described a new form of gear which has been developed by the General Electric Co. for use in ship propulsion. The design is such as to afford a distribution of strain, and means by which excessive strain would not be imposed upon any part through slight imperfections, distortions, or inaccuracy. The gear is built up of a number of plates machined to a form which gives them the desired degree of lateral flexibility. These plates are put together, engaging solidly at the hub, and also engaging on a narrow edge at the periphery. When so put together, they form a solid cylinder, which can be cut spirally in the ordinary manner. After cutting, the edge engagements are released with a small dividing tool, so that each disk operates independently, and is free to deflect laterally under the side pressure which results from its diagonal engagement with the pinions. The parts are so proportioned that the lateral deflection can at no time involve fibre strain which could possibly cause destructive fatigue.

Gears of this character have been applied to 72 sets in which steam turbines drive electric generators, and contracts have been closed for machinery aggregating 215,200 H.P. for the propulsion of 70 ships. Some of these electric generating sets have been in service for a year and a half.

Gears of the Alquist type are applied in three ways: First, a single reduction has been accomplished by engaging one solid pinion with a flexible gear; second, by engaging a solid pinion with two flexible idlers, which in turn engage with a solid large gear; and third, in a double reduction where a solid high-speed pinion engages flexible gears on two countershafts, these countershafts carrying solid pinions, both of which engage a flexible gear on the same low-speed shaft. In the last two applications the flexibility of the gears serves to equalise the load between all the driving points and the use of a plurality of driving points on the large gear reduces the length of face necessary on that gear.

From experiments made at Schenectady, it would appear that gears are more efficient at low speed than at high speed. Solid gears at low speed involve difficulties, because they diminish pinion diameters and increase pinion lengths, whereas the flexibility of the Alquist gear enables one to compensate easily for all possible degrees of torsional yield in the pinion: and with such gears the peripheral speed can safely be reduced by making the gears longer and of smaller diameter.—*Power.*

Shipyard Labour.—The Secretary of the Admiralty announces that the Shipbuilding Employers' Federation and the Engineering Employers' Federation have nominated the undermentioned gentlemen to represent them respectively on the Advisory Committee which has been constituted in association with the Shipyard Labour Department of the Admiralty:—

Shipbuilding Employers' Federation: Mr. G. J. Carter, Mr. W. H. Dugdale, Mr. F. N. Henderson, Mr. Herbert Howell, Mr. M. C. James, Mr. N. E. Peck.

Engineering Employers' Federation: Mr. W. H. Allen, Mr, Thomas Bell, Mr. James McKechnie, Mr. D. S. Majoribanks, Mr. Allen N. Smith, Mr. W. Rowan Thomson.

Tudor Accumulator Co., Ltd.—The date for sending in tenders for the purchase of shares in this company has been extended by the Public Trustee from February 5th to February 26th. An advertisement appears elsewhere in this issue.

Institution and Lecture Notes.—Physical Society of London.—At the meeting held on January 26th, a paper, entitled "A Clock of Precision," was read by Mr. C. O. Bartrum. The principal feature of the author's arrangement is the employment of a "slave" clock to do the great part of the work, leaving the master pendulum no function beyond that of controlling the rate of the other. The master pendulum swings freely except for a short period (about one-fifth of a second) every minute, during which it receives an impulse from a small falling pallet electromagnetically released by the slave clock. At the end of its fall the pallet closes a second circuit and is restored to its initial position. These two electric circuits also energise parts of the mechanism in the slave clock by which the latter is kept in time with the master pendulum. The lagging of correction behind error, with the resulting periodic fluctuation in the rate, is reduced almost to the vanishing point by the introduction of a "negative backlash" in the control mechanism. The paper contains a mathematical discussion of the best working conditions and of the possible magnitude of errors which might arise from various causes.

A paper on "The Effect of Water Vapour in the Atmosphere on the Propagation of Electromagnetic Waves," by Dr. Frederick Schwers, was taken as read. It was shown that the lowest layers of the atmosphere (1,000 to 1,500 metres approximately in depth) refract electromagnetic waves towards the earth, so that the greater part of the space waves will reach the receiver, contrary to the conclusion of Kiebitz.

Institution of Electrical Engineers.—At a meeting of the Western Local Section, at the Merchant Venturers' Technical College, Bristol, on Monday last, Mr. J. S. Peck read his paper on "The Parallel Operation of Electric Power Stations." Mr. W. A. Chamen (general manager, South Wales Power Distribution Co.) opened the discussion, and was followed by Mr. G. Morley New (Cardiff tramways), Mr. A. T. Kinsey (Bristol Post Office telephones), and Prof. David Robertson (Bristol University). The contributions to the discussion and Prof. Robertson's remarks on the synchronising torque of two generators with slight phase displacement varying with the total impedance of the two generators and interconnecting link, illustrated by blackboard diagrams, were of a highly interesting nature. Mr. Peck briefly replied.

The Society of Engineers (Inc.).—Amongst the premiums awarded by the Council for papers read before the Society during 1916, was the Bernays Premium, to Prof. J. A. Fleming, for his paper on "Engineering and Scientific Research." On February 5th, Mr. Henry C. Adams, President for the year 1917, delivered his inaugural address, in which he pointed out the desirability of some federation of engineering bodies, and outlined a scheme for such a federation, with a general engineering council for its head, and representing all sections of the engineering profession, the specialist societies being co-ordinated, and forming, in effect, branches of the main body. This general council would wield enormous power, both in moulding public opinion and in upholding the status and interests of the profession as a whole. He then dealt with the classification and training of engineers, and the great need for the more general recognition of science in all branches of education, and, in conclusion, he suggested that the time was opportune for the reform of our present system of weights and measures, and the adoption of the metric system.

Diesel Engine Users' Association.—The January meeting of the Association was held at the Institution of Electrical Engineers, London. The president, Mr. Geoffrey Porter, submitted a table of data concerning lubricating oils, and a paper on the chemistry and examination of these oils was read by Mr. E. A. Evans, which will be discussed at the next meeting.

The Faraday Society.—A general discussion on "The Training and Work of the Chemical Engineer" will be held on Tuesday, March 6th, at 8 p.m., in the rooms of the Chemical Society, Burlington House, W. Sir Robert Hadfield, F.R.S., president, will preside. The discussion will be opened by Sir George Beilby, F.R.S., and the following papers will be read :—

Prof. F. G. Donnan, F.R.S., "The Training of the Chemical Student for Work in the Factory."
Mr. Charles R. Darling, "The Training of the Works Chemist in Physics."
Mr. W. R. Cooper, M.A., B.Sc., "A Plea for the Forgotten Factor in Chemical Training."

Among those who have signified their intention of contributing to the discussion are Dr. E. F. Armstrong, Dr. Charles Carpenter, Dr. Dugald Clerk, F.R.S., Prof. E. G. Coker, F.R.S., Dr. S. Z. de Ferranti, Mr. A. P. M. Fleming, Prof. A. K. Huntington, and Dr. F. M. Perkin.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Whilst Mr. C. J. Spencer, the manager of the Bradford City Tramways, is fulfilling his duties for the Admiralty as organiser of labour in shipyards, his duties of management at Bradford are to be shared by Mr. T. Shirk (traffic superintendent) and Mr. J. W. Dawson (assistant engineer).

The Exeter Electricity Committee having received applications for increase of salary from members of the electrical engineer's staff, recommends that the maximum in each case be raised as follows :—First shift engineer, £120 to £140 ; second shift engineer, £100 to £120; third shift engineer, £100 to £120 ; foreman engineer, £2 2s. to £2 5s. ; the Committee to be empowered to graduate the pay within the scale as it may deem expedient.

The Manchester City Council has decided that the accountancy and secretarial departments of the electricity department shall be separated, and both placed under the control of Mr. S. L. Pearce, whose title shall be chief engineer and manager. He will be the official responsible to the Committee for the efficient working of the electricity department.

The Leeds Corporation is recommended to appoint Mr. Ernest Porter to be superintendent of the new electricity generating station, at £280 per annum ; Mr. H. Topham to be engineer-in-charge, at £140 ; and Mr. C. H. King works foreman, at £182.

The Peterborough Council has resolved to increase the salary of Mr. Rowland, the acting electrical engineer, from £208 to £278 per annum. The Electricity Committee reported that during the time that Mr. Rowland had been acting as city electrical engineer (20 months), following the death of Mr. Gill, who was both waterworks and electrical engineer, with Mr. Rowland in charge of the electrical department, he had carried out the duties of the office to its entire satisfaction. It accordingly recommended that he be now appointed to the office of city electrical engineer ; this part of the recommendation, however, was not confirmed.

General.—Lieut. A. Reginald Courtenay, who, until June, 1915, was acting manager of the Publicity Department of the General Electric Co., Ltd., was married on Saturday last, at St. Paul's Church, Onslow Square, to Miss Edith Ashworth, daughter of Dr. J. H. Ashworth, of Cliftonville.

The King has appointed the Marquess of Crewe to be a member of the Committee of the Privy Council for the purpose of the organisation and development of scientific and industrial research.

Mr. Ernest Wigglesworth, head of the fitting shop of one of the departments of the Phœnix Dynamo Manufacturing Co., Ltd., Thornbury, Bradford, and who has just resigned, was the recipient, last week, at a large gathering in the café at the works, of a gold albert, the gift of the firm and the workers in the department. A musical programme followed.

Mr. C. J. Hunt, who until recently was chief contract engineer to Bruce Peebles & Co., Ltd., Edinburgh, has been appointed chief engineer to the company, and Mr. Wm. Oliver, who has for some time been acting chief estimating engineer (in the absence of Mr. R. Shaw, on active service) has been appointed chief contract engineer.

Obituary.—Mr. H. G. Stott.—The death occurred on January 15th, in New Rochelle, of Mr. Henry Gordon Stott, superintendent of motive power to the Interborough Rapid Transit Co. and the New York Railways. The *Electric Railway Journal*, in an account of his career, states that he was born in the Orkney Islands in 1866. After an electrical and mechanical education and training in Scotland he became an assistant electrician on the *Minia* (Anglo-American Telegraph Co., Ltd.), and was an expert in matters relating to cable repair. He was identified with the duplexing of the United States Cable Co.'s main cable (2,750 knots). In 1889 he was assistant engineer for the Brush Co. at Bournemouth, and later he joined Hammond & Co. for cable and power station work at Madrid. In 1891 he went to the States for cable and conduit work for Buffalo electrical companies, and for 10 years he was prominently identified with the industries of Buffalo. In 1901 he took up his post with the Interborough Co. Mr. Stott was president of the American Institute of Electrical Engineers in 1907-8, and was very closely connected with other American engineering organisations. He was an ardent advocate of the metric system, and had written a large number of papers on various engineering problems. Mr. Stott had been ill for many months.

Mr. A. P. Collins.—The death is announced, at the age of 28 years, of Mr. Alfred Percy Collins, electrical engineer at the Taunton Lyceum. Deceased died from heart failure following pneumonia. He was trained at the works of Messrs. Edwards and Armstrong, of Bristol.

We desire to tender our sympathy to Dr. J. A. Fleming, F.R.S., whose wife passed away on 6th inst., at Hampstead, after a very short illness, aged 53 years.

Roll of Honour.—Sergeant Mark Bogg, West Yorkshires, a winner of the Military Medal, is reported to have died of wounds received in action. He was formerly in the Electric Lighting Department of the Leeds Corporation.

Private William Booth, of the Grenadier Guards, who has died in hospital at Caterham, was, before joining the Army, apprenticed to an electrical engineering firm at Halifax.

The Military Medal for bravery in action has been awarded to Sapper David Benton, R.E., who was, as an electrician, at Harrison's Colliery, Wyrley (Staffs.).

The D.C.M. has been awarded to Lance-Corporal G. W. Howes, R.E., who was an electrician at the Brymbo Steel Works, near Wrexham.

The Serbian Silver Star decoration, in recognition of distinguished services rendered during the campaign in that country, has been conferred by King Peter upon Flight-Sergeant A. Forsyth, Royal Flying Corps, who was for some years with the British Thomson-Houston Co., Ltd., at Rugby.

Private Hy. Wogden, of the electric power station staff, Sculcoates Lane, Hull, is reported killed in action.

Lieut. ERIC GORDON WATERS, attached to the Royal Flying Corps since June last, was killed in France in an aerial combat on January 24th, 1917. He had been with Messrs. Callender's Cable Co. and Messrs. Ferranti prior to joining the Forces in 1914. His death occurred while he was escorting another flyer who was taking photographs. Both were attacked by two hostile scout machines. Lieut. Waters engaged one of them, and during the encounter the Hun dived on him and he was hit, and must have been killed instantaneously. His observer managed to land the machine in our lines. Lieut. Waters would shortly have been given a Flight Command; he was regarded as his Captain's right-hand man.

CITY NOTES.

Llandudno and Colwyn Bay Electric Railway, Ltd.

The profit for the year ended November 30th, 1916, after providing for ordinary operation and administration expenses and interest on debenture stock and loans, was £5,317, as against £5,414 for 1915. Exceptional maintenance charges not applicable solely to the year under review, and amounting to £1,496, have been debited to reserve account. The net results have been affected by the difficulties of obtaining labour and the increased cost of materials, and also the curtailment of public holidays and week-end facilities by the railway companies. Adding £432 brought forward, the available total is £5,749. £1,615 is applied in providing for the sinking fund instalment due January 1st, 1917, a dividend of 4 per cent., less income-tax, is to be paid, and £158 carried forward. The full amount of sinking fund instalment due January 1st, 1917, has been charged in the accounts, and this provision is considered sufficient to meet the depreciation of the system. No construction work has been carried out during the year, and certain alterations which the directors have in mind, with a view to improving running conditions, must necessarily stand over until more normal times are reached.

Dublin United (Electric) Tramways, Ltd.

MR. WM. M. MURPHY presided at the annual meeting on Tuesday. He said that the company had suffered a loss of at least £15,000 by the Easter-week rebellion, and it was hoped to get back in compensation a substantial part of that sum. The continuous growth of traffic was shown by the remarkable way in which they recovered themselves during the year, coming out with £1,435 in excess of the gross receipts of 1915. The gross receipts—£335,335—were, he said, the highest in the history of the company. The passenger receipts increased £1,850 over 1915, but as there was some falling off in parcels, the actual increase in gross receipts was £1,435. During the first three months of the year 1916—January, February, and March—the receipts were £4,297 above the corresponding months in 1915, and there was almost a certainty that they would go on growing at the same rate of over £1,400 a month. Then came the fatal month of April, and in the two months of April and May, instead of gaining nearly £3,000 which they had reason to anticipate, they lost £13,898. From the end of May they began to pick up again, and they came out at the close of the year, as he had said, with £1,435 to the good. The expenses were also a record, being £11,478 in excess of 1915. Of this excess, the single item of coal accounted for £5,219, though the quantity consumed, owing to saving effected by various mechanical and electrical economies, was less by 1,230 tons. They had now £60,000 in hand for relaying of tracks when material was available. The meeting passed a resolution approving the conversion of the whole of the fully-paid preference shares into preference stock, and the conversion into stock of 66,000 ordinary shares issued and fully paid, to be called ordinary stock. The balance of the authorised capital, viz., 4,000 ordinary shares of £10 each, may also be converted into ordinary stock when issued and fully paid.

Yorkshire (West Riding) Electric Tramways Co., Ltd.

At the annual meeting, held in London last month, SIR H. S. LEON, who presided, said that the expenditure for the year was £47,474, and the total income £90,364, leaving £42,890. The income increased by £9,277 (11 per cent.), or on a car-mileage basis 1.233d. per car mile. The receipts per car mile were 12.267d., against 11.034d., and the working expenses 6.445d., against 4.882d. The net receipts from the Pontefract lighting undertaking at £544 increased by only 5 per cent. The increase in revenue was satisfactory, but increase in expenditure more than counterbalanced the gain. In all probability expenses would always remain higher than in pre-war times, a fact which they must face with resignation. In the aggregate, the working expenses increased by £11,595, equal to 32 per cent., or 1.563d. per car mile. The percentage of expenses to receipts was 52.54 per cent., against 44.25 per cent. for 1915, and the percentage of net revenue to receipts was 47.46 per cent., compared with 55.75 per cent. They carried 1,285,791 more passengers (increase 11 per cent.), and had run 4,305 more miles (increase 0.2 per cent.). The report was adopted. At an extraordinary meeting which followed, the chairman explained the scheme for dealing with the arrears of cumulative preference share dividends. Each £5 preference share (August, 1905) is entitled to £2 3s. 2d. of the new stock; the shares issued in September, 1905, to £2 2s. 7d.; those issued in November, 1905, to £2 1s. 11d. The average per cent. was £43 2s. 1d., and the total amount was £99,703. Roughly, anyone holding 35 shares had £75 of the new stock. The proposal was adopted. A meeting of preference shareholders followed, at which the proposal was approved. A vote of thanks was passed to the directors, and to Mr. England, the manager.

Lanarkshire Tramways Co.

For the year ended December, 1916, the revenue was £126,630, and the expenses were £78,762, leaving £47,868. After deducting contributions payable to local authorities, debenture, and other interest, £11,000 placed to reserve for depreciation, £2,500 put to maintenance reserve, £2,230 written off investments, and adding £958 brought forward, there is a balance of £23,602. 6½ per cent. dividend absorbs £22,295, the directors take £549 (percentage of the profits), and £758 is carried to revenue new account. The revenue shows an increase of £20,586, and the expenses an increase of £12,671, as compared with the revenue and expenses for the year 1915. It has been impossible, however, owing to shortage of labour and difficulty in obtaining materials, to maintain the undertaking in the usual state of repair, and £2,500 has been transferred to maintenance reserve account in order to make some provision for the repairs which will have to be undertaken when the war is over. Contributions payable to local authorities are £1,135 in excess of the amount for the year 1915. During the year £3,100 debentures of the company were purchased or redeemed. It is not proposed at present to fill the vacancy on the board created by the death of Sir George Franklin.

Sunderland District Tramways, Ltd.—The report for the year ended October 31st last states that after charging the expenses of operation and administration for the year ended October 31st, 1916, and providing for depreciation of rolling stock, &c., there remains a balance of £11,946. Interest on the prior lien bonds and first mortgage debentures absorbs £7,100, sinking fund instalment £500, depreciation of investments £500, transfer to general reserve account £1,514, leaving £2,983. The directors recommend the payment of interest at the rate of 3 per cent. per annum (less income-tax) on the first income bonds, leaving £881 to be carried forward. The traffic receipts show an increase of £2,486, but, owing to the war, the working expenses have been proportionately higher, the net result of the year's operation being an increase in the profit of £1,087.

Metropolitan Railway Co.—In the interests of economy, the next report will only be issued to proprietors who apply for it—if the war lasts. The report for 1916 now issued is curtailed in several sections. The total net income was £609,126, plus £13,041 brought forward. Interest, rentals, appropriations to renewals, &c., were £305,228, dividend on the preference stocks £237,794. After paying 1 per cent. for the year on the ordinary stock, £14,492 is to be carried forward; £20,000 has been carried to general renewals fund, as against £15,000 in 1915. As regards the company's claim for consideration in respect of new lines brought into use since 1913, the Government has now agreed that the company is entitled to a payment for interest on the capital so expended. The annual meeting was held yesterday.

St. James' & Pall Mall Electric Light Co., Ltd.—The directors recommend a balance dividend on the 7 per cent. preference shares for the half-year ending December 31st, 1916, of 3s. 6d. per share, and 5s. 6d. per share on the ordinary shares, making, with the interim dividend, a total of 8 per cent. for the year.

Cambridge Electric Supply Co., Ltd.—Total profit for 1916, £7,096, plus £2,753 brought forward. Debenture and other interest require £1,783, £1,000 is placed to depreciation fund account, the dividend for the year is 5 per cent., and £2,607 is to be carried forward. Annual meeting: February 28th.

City of Buenos Aires Tramways Co. (1904), Ltd.—The directors recommend a balance dividend of 1s. 3d. per share (making 5 per cent. per annum), less income-tax. £5,500 is to be transferred to the general amortisation fund and £108 carried forward.

Edison Swan Electric Co., Ltd.—Separate meetings of the holders of the 4 per cent. first and 5 per cent. second debentures are to be held on February 12th, to consider the scheme of arrangement between themselves and the company.

National Gas Engine Co., Ltd.—The directors recommend a final dividend of 3¾ per cent., making 7½ per cent. for the past year, also a bonus of 9d. per share, free of tax, on the ordinary shares.

Yorkshire Electric Power Co.—Net profit for 1916, £29,112, as against £21,209 for 1915. After paying 3 per cent. on the ordinary shares and transferring £12,000 to reserve, £3,866 is to be carried forward.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the four weeks of December, 1916, amounted to 1,751,753, compared with 1,393,927 units in 1915.

Parsons' Marine Steam Turbine Co,, Ltd.—Dividend, 10 per cent., free of income-tax, for the half-year.

STOCKS AND SHARES.

TUESDAY EVENING.

United States developments have been the prevailing consideration in the Stock Exchange this week. Even interest in the War Loan subsided for the time being after January 31st had passed, and intending applicants argued that there was no particular hurry for them to send in their cheques for a few days. Next week, of course, there will be a big rush for the loan, and the meetings which are being held during the present days are certain to provide a good deal of extra money.

At the same time, the observer cannot help feeling that where the appeal is being made so strongly to the small investor, more might be done in the way of elucidating details. For instance, those in close touch with the matter know that one of the chief objections, which hundreds of small investors have to parting with their money for the loan, is the feeling that they will not be able to touch their capital for twelve years, whether they want to or not.

The stream of selling to take up war stock has diminished to a noticeable extent, and markets are beginning to recover here and there. Underground Electric incomes, which make a fair example of the stocks which were being sold, are up again to 90½. The Treasury's modification of its announcement with reference to the prohibition of securities being sent abroad has released business to some extent in the stocks affected; but, even now, the official statement is so ambiguously worded that the explanation does not wholly satisfy some of the people concerned. Nobody would wish to harry the Treasury with carping criticism, but, at the same time, the business-man does feel that it is a pity for these announcements to be so hastily hotchpotched for immediate issue that they have to be modified or explained a few days later.

The entrance of America into the area of the war made very little difference in the Stock Exchange on this side. There was a small slump at first in Wall Street, immediately followed, however, by substantial recovery. Opinion in the London Stock Exchange views the position with satisfaction, the chief bull point about it being that the financial resources of America will undoubtedly prove a great asset for the cause of the Allies.

Some think that Germany intended to force the United States into the war in order that Germany might be able to obtain better terms over peace proposals; and there is a half-fear expressed that President Wilson may play into the hands of the foe by advocating a much milder policy in this respect than would be acceptable to those nations which have suffered so much during the past two and a half years, throughout which the United States has made money hand-over-fist out of the commercial side of the business.

To come from the abstract to the concrete: the London electricity supply companies' list is rather better, for which, no doubt, the main cause is the Westminster Co.'s dividend of 9 per cent., making 7 per cent. for the year—the same as that which was declared for 1915. This came as a pleasant surprise, and rumour immediately gossiped about a similar result being achieved in the cases of the Charing Cross, the County, and the City of London Companies. Prices, however, are left much as they were. South Metropolitans are wanted; and instead of being 17s. 6d., as they were this time last week, the price is nearer 18s. 9d., with buyers about.

The Edison Swan Electric Co. has issued a circular to its debenture stock holders, outlining the heads of a scheme for providing further working capital for the purpose of the business. A scheme of arrangement has been drawn up as between the company and its debenture stock holders and members, in which proposals are put forward that shall reorganise the present capital and, at the same time, provide the company with £100,000 additional money. The board appeal to the stockholders to support the scheme, and, to facilitate its confirmation, ask that proxies shall be signed and returned by Saturday in this week at the latest.

We understand unofficially that the Treasury has raised objections to more capital being issued, notwithstanding the particular activities of the Edison Swan Co., and the fact that the fresh money is required for the development of this part of the business. Possibly official sanction will be less difficult to obtain after the War Loan lists are closed.

Central London stocks remain dull, apparently because of a fair-sized block which is overhanging the market, and which is said to be on behalf of a deceased account. Metropolitans are ¼ better, and Districts also have a harder tendency; while Underground income bonds have risen, as we mentioned earlier, to 90¼. The railway market as a whole is cheered by the increase in the Hull and Barnsley dividend from 2 per cent. to 3 per cent., made possible by the Government's willingness to pay interest on capital expenditure laid out since the war started.

Marconis are enjoying a more active market and better prices, the ordinary having risen to 2⅛, Americans to 17s., and Canadians to 9s. 3d. The improvement is said to be due partly to shortage of shares, as disclosed by buying orders based upon the expectation of the Government bonus becoming known before long; while another suggestion advanced is that the latest outbreak of German frightfulness will render the Marconi system more essential than ever. Whatever may be the reason, the market is certainly more active that it has been during the past few months, and there is some talk of the rise not having yet exhausted itself.

American-Canadian stocks fell with an abrupt jerk at the end of last week, what time Yankee rails came hurtling down on the President's message to Congress. They shared in the partial recovery, and on balance there is not much change in the prices of issues connected with the light and power companies. Brazilian Tractions were slightly tarred with the same brush, the price giving way on the prospect of Brazil joining the United States in breaking off diplomatic relations with Germany. The fall on the week, however, is no more than a point, and the preferred shares have not been affected. Argentines are steady.

The Mexican group, after showing firmness, eased off. It was stated last week that half the American Army had been massed on the Mexican frontier, and that the other seven men were about to follow! As a matter of fact, however, no definite news is forthcoming, and the little rise which occurred in some of the railway stocks, and which had a strengthening effect upon various Mexican industrials, shows signs of petering out.

The miscellaneous market, on the whole, is on the dull side. Electric Constructions stand out with exceptional firmness at £1, but falls have taken place in British Aluminium ordinary, Callenders, Castner-Kellners, and Edison Swan fully-paid shares. British Insulated are better at 11⅞. The rubber share market is quiet, with next to nothing doing; while in the armament and the copper sections, movements are irregular and narrow.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1914.	Dividend 1916.	Price Feb. 6, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅝	—	7 8 2
do. do. 4½ Pref.	4½	4½	3¼	—	6 18 6
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9⅜	— ¼	6 8 1
County of London	7	7	10	—	7 0 0
do. 6 per cent. Pref.	6	6	9⅜	—	6 8 1
Kensington Ordinary	9	7	8⅝	—	6 10 3
London Electric	4	3	1½	—	7 2 10
do. do. 6 per cent. Pref.	6	6	4 15/16	— ⅛	6 19 1
Metropolitan	3½	3	2½	—	6 18 4
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅝	—	6 19 0
South Metropolitan Pref.	7	7	1 7/16	—	6 7 8
Westminster Ordinary	9	7	5⅛	—	6 4 5

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	94½	—	6 7 2
do. Def.	80/-	88/6	22	— ½	6 16 4
Chile Telephone	8	8	7	—	5 14 3
Cuba Sub. Ord.	5	5	8½	—	6 8 6
Eastern Extension	7	8	12⅝	—	*5 15 4
Eastern Tel. Ord.	7	8	15⅞	—	*5 16 10
Globe Tel. and T. Ord.	6	7	11⅞	— ⅛	*5 18 0
do. Pref.	6	6	9⅝	—	6 1 6
Great Northern Tel.	22	22	36	—1	6 2 3
Indo-European	13	13	49	—	6 12 8
Marconi	10	10	2⅝	+ 1/16	3 9 6
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2½	—	4 9 0
United R. Plate Tel.	8	8	6⅝	— 1/16	*5 5 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	12⅞	—	*5 15 4

HOME RAILS.

Central London, Ord. Assented	4	4	62½	—2	6 8 0
Metropolitan	1½	1	23½	+ ½	4 6 6
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	2	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	90½	+1	*6 12 7

FOREIGN TRAMS, &c.

Adelaide Sup. 6 per cent. Pref.	6	6	11⅜	—	6 1
Anglo-Arg. Trams, First Pref.	5½	5½	9	—	9 4
do. 2nd Pref.	5½	5½	9⅜	—	—
do. 5 Deb.	5	5	6½	—	7 15 0
Brazil Tractions	4	4	49	—1	8 3 4
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Ry. Pfce.	5	5	61	—1	8 4 0
do. do. Preferred	—	Nil	43	—1	Nil
do. do. Deferred	—	Nil	38½	—	Nil
do. do. Deb.	4½	4½	64	—	6 13 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
2nd do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common	Nil	Nil	7⅜	—	Nil
do. Pref.	Nil	Nil	14⅜	—	Nil
do. 1st Bonds	Nil	Nil	27½	—	—

MANUFACTURING COMPANIES.

Babcock & Wilcox	14	15	21 5/16	— 1/16	5 11 6
British Aluminium Ord.	5	7	27/-	—6d.	5 13 6
British Insulated Ord.	15	17½	11⅞	+ ⅛	7 7 4
British Westinghouse Pref.	7½	7½	9½	—	6 13 4
Callenders	15	20	12½	— ½	8 0 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	30	— ½	7 1 0
Edison & Swan, £8 paid	Nil	—	7/16	— 1/16	Nil
do. do. fully paid	Nil	—	1/16	— ¼	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	1	+ 1/16	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	13⅝	—	7 5 6
Henley	20	25	15½	—	7 18 9
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	— ½	*8 3 4
Telegraph Con.	20	20	38	—	*6 5 0

* Dividends paid free of income-tax.

SELF-PROPELLED ELECTRIC VEHICLES AND THEIR APPLICATIONS.

In a paper recently read before the Institution of Engineers and Shipbuilders in Scotland, by Mr. L. Broekman, the author pointed out that electric vehicles can be classified under two principal heads:—

Utility Vehicles.—Industrial vans and wagons.
Public service conveyors and road appliances.
Road tractors, couple gear, and locomotives.
Workshop trucks and tractors.
Passenger Vehicles.—Commercial and inspectors' runabouts.
Ambulances and motor chairs.
Omnibuses and taxi-cabs.
Pleasure cars.

He considers that a sweeping reform in the means at our disposal for road transport of merchandise has long been overdue, pointing out that some means must be taken of quickening the circulation in our busy areas. Individual owners have obtained improved service, especially for remote deliveries, by using petrol motors, but for short-distance work, entailing frequent stopping and restarting, such vehicles are not suited nor economical, hence horse haulage has been little reduced for such work.

Some 80 per cent. of the freight movement in the streets still depends on horses, and such traffic, with rare exceptions, progresses at the rate of from two to three miles an hour, if at all, and the author asks how we are to speed-up such traffic to meet coming commercial activity unless energetic measures are promptly taken to abolish, counteract, or remedy the obstructions to rapid flow of traffic.

The point raised by Mr. Broekman is interesting; we some time ago suggested in these columns* that one remedy would

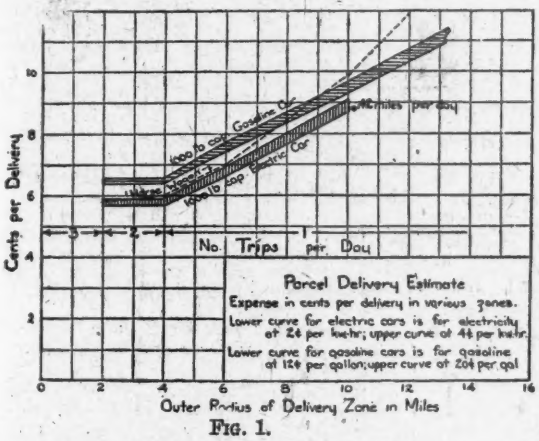

Cents per Delivery
Gasoline Car
Electric Car
No. Trips per Day
Parcel Delivery Estimate
Expense in cents per delivery in various zones.
Lower curve for electric cars is for electricity at 2¢ per kw-hr; upper curve at 4¢ per kw-hr.
Lower curve for gasoline cars is for gasoline at 12¢ per gallon; upper curve at 20¢ per gal.
Outer Radius of Delivery Zone in Miles

Fig. 1.

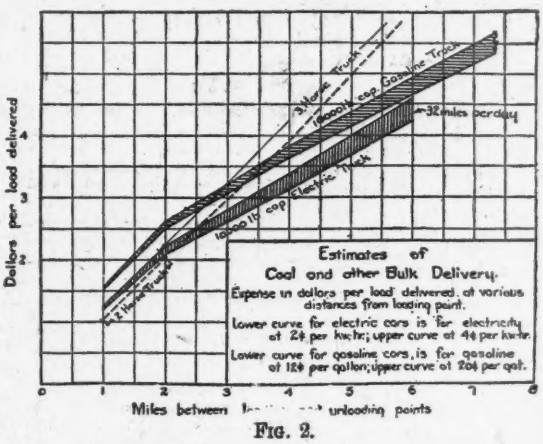

Dollars per load delivered
3-Horse Truck
Gasoline Truck
Electric Truck
Estimates of
Coal and other Bulk Delivery.
Expense in dollars per load delivered, at various distances from loading point.
Lower curve for electric cars is for electricity at 2¢ per kw-hr; upper curve at 4¢ per kw-hr.
Lower curve for gasoline cars, is for gasoline at 12¢ per gallon; upper curve at 20¢ per gal.
Miles between ... unloading points

Fig. 2.

be to impose a definite speed limit, which all vehicles in crowded streets should be capable of attaining, such a procedure being much more logical in connection with an intrinsically valuable artery of communication in a crowded city than the imposition of speed restrictions on a country road, which has a low "communication value."

He rightly says that so long as horses are allowed for city haulage—and team owners with their allied forces will naturally put up a big fight to keep them there—real betterment is out of the question, and suggests three remedies:—

1. Officially to divert the swifter traffic from main thoroughfares, reserving direct routes for slow haulage.
2. Use a far larger number of motor vehicles.
3. Freight clearance to be effected by double shifts, day and night.

No. 1 appears to us to suggest a reversal of the usual procedure, and to put an unmerited premium on slow-moving traffic.

The author then discusses at length the well-known advantages of the electric vehicle as the best fitted to supersede horse traction, pointing out that its silent operation and freedom from fire risk are much in its favour for night work. Increased mileage can be provided for either by boosting charges or battery exchange. Commercial vehicles usually have battery capacity for 40 miles on a single charge, and experience proves that from 30 to 35 miles per day is the usual demand for average city and suburban work.

To increase the battery capacity above this would only add weight and cost needlessly.

The ratio of working days in commission to total number of working days during a period comes out at the fine average of 95 per cent. for the "Electric," as compared with petrol lorries, 90 per cent.; steam lorries, 85 per cent.; and horses, from 65 to 85 per cent.

The 500-volt tramway motor has run 250,000 miles with only minor repair due to wear; the usual pressure for delivery vehicles is 60 or 80 volts, and, being practically constant, racing by sporting drivers is made impossible, which coupled with sturdy, simple design accounts largely for immunity from breakdown.

The battery can be drawn on for lighting purposes during loading and unloading, and power appliances, such as winches, capstans, tipping gear, &c., can be operated from it. The diagrams in figs. 1 and 2, showing relative cost of service, are based on the road transport report issued by the Mass. Institute of Technology; the actual figures are, of course, based on American conditions before the war, but show the advantages of electric haulage at that period in the States, which advantages are increased considerably since the cost of petrol and fodder has increased.

One outstanding advantage of the electric vehicle is that all debit items can be determined beforehand to a small fraction of a penny. The change over from horses to motors can do no good unless the daily performance of each vehicle is arranged and scheduled to a time-table; routes, stops, and loading times appointed and checked against reports, labour-saving devices brought into use, and the movement of drivers and helpers speeded up. Garage supervision is also of vital importance, for if the electric ever fails at all, it is not through service in the streets, but through slackness at the garage. Drivers' reports and garage records should be insisted upon; fig. 3 shows some monthly charts of a large public supply company in New York. It will be noticed that the energy consumption for October shows a considerable increase for the larger vehicles, probably due to snow, &c.

The high speed of the petrol motor on the open road gives it a field of usefulness which is freely admitted, but does not clash with the battery vehicle which is intended for town and suburban service, where the legal limit of 12 miles an hour is rigidly enforced; this distinction should be clearly realised. High speed, on the other hand, means extra repairs and maintenance, and led to the introduction of sealed governors on petrol motors, definitely limiting the speed.

In traffic the electric vehicle, due to self-starting and rapid acceleration, gets there as quickly as the speediest vehicle. Weight operated against the battery vehicle in the early days, but now there is probably not much difference as between modern petrol and electric vehicles, and the latter have a superior weight distribution.

The total friction losses account for only about 70 watt-hours per ton mile; the mean energy consumption on give-and-take roads of fair surface is about 120 watt-hours per ton mile (vehicle and load) on the day's performance.

For a two-ton capacity vehicle, running under an average load of one and a half tons all day, this works out at less than 1 h.p. per hour per vehicle mile, which is clear proof that the tare weight is not a serious drawback.

The author points out that on the cost basis, comparing five-ton battery and petrol vehicles costing £1,105 and £875 respectively, and allowing 10,000 miles a year, the electric delivery would cost £558, and the petrol delivery £591, showing a saving of £33 in operating cost, which equals nearly 15 per cent. per annum on the additional capital, and does not include the 5 per cent. additional service reliability. As regards the latter, data regarding pleasure cars obtained six years ago shows one electric was towed in for every 8,500 miles, and over an average distance of 1 3/10 miles, while one petrol car was towed in for every 3,000 miles, over an average distance of eight miles.

The paper contains descriptions of several of the leading commercial electric vehicles, such as the Orwell, G.V., and Electromobile; the accumulator is discussed at some length, attention being drawn to the development of the "ironclad exide," and the use therein of armoured pencils homogeneously connected in parallel rows to form plates, and to supersede the flat positive electrode; also to the advantages of the Edison nickel-alkali accumulator.

Of the 70 watt-hours per ton-mile average required to overcome frictional losses, from 40 to 50 watt-hours are absorbed in tires alone; the tire maker's usual guarantee of 10,000 miles per annum is habitually exceeded by electric vehicles.

Comparative figures of cost published in the *Power Waggon*

* Elec. Rev., March 27th, 1914.

relative to a large organisation using 107 horsed vehicles and 130 horses, show an average performance per month per vehicle of 383 miles of half-ton loads, costing £24 11s., and equal to 30.6d. per ton-mile; 52 electrics carried an average per month per vehicle of 749 miles of one-ton loads, costing £38 13s., or 12.37d. per ton-mile. The ratio is thus 2.47 : 1 in favour of electric vehicles.

A section of the paper deals with special applications, such as refuse collection, street sprinkling, coal-tipping wagons, tower and pump wagons, road rollers, fire appliances, shunting locos and tractors, couple-gear tractors for attaching to existing horse vehicles, battery trucks and tractors for small loads, electric pleasure cars, taxi-cabs, omnibuses, &c.

The author states that American data shows that the entire upkeep and running costs to be debited against an electric

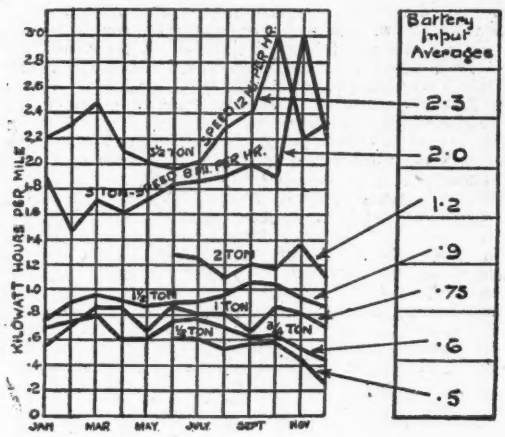


Fig. 3.

pleasure car if attended to at a garage and brought to the owner's house daily, are for 6,000 miles a year, 6½d. per mile, and for 12,000 miles yearly, 5d. per mile.

If present-day inducements are considered dispassionately, electromobiles for personal use are a thoroughly sound proposition.

In Detroit, a petrol motor manufacturing centre, the average costs of electric taxis over two years work out at only two-thirds of those for petrol cabs, and people show a preference for them.

The paper concludes with a series of detailed tables showing approximate running costs for vehicles of 15 cwt. up to five tons carrying capacity, which will be useful for reference to vehicle users.

In the discussion on this paper (for which we are indebted to the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland), Mr. W. W. Lackie (President) said that only four years ago the Glasgow Corporation purchased its first electric vehicle, and after running 27,000 miles it was in as good a condition to-day as it was at the beginning of its career; it had given such satisfaction that three other vehicles had been purchased, and all had given excellent results. The ease with which electric vehicles could be manipulated, even by men without previous experience of driving them, had appealed to him. The Glasgow vehicles had been in use for 300 days out of 365. The Glasgow cleansing department had recently purchased an electric vehicle for removing waste material, and he had no doubt that the citizens would appreciate the quietness with which the work was carried on during the night.

Mr. J. Hally Craig agreed with the general remarks by Mr. Broekman in introducing his subject, though he thought it possible to make out an even stronger case for the electric vehicle. For example, Mr. Broekman took the coefficient of reliability at 95 per cent.; his experience showed that a much higher figure was obtained. A three-ton lorry in use by the Vale of Leven Co-operative Society, Ltd., was in service delivering bagged coal to consumers, and its customary duty was five trips per day, starting out with three tons. The first calendar year of its service it actually delivered coal on 307 days—the remaining 59 days were Sundays and holidays. One afternoon, and the following morning, the vehicle was out of service owing to a trifling mechanical, not electrical, defect, and this record showed a reliability coefficient of 99.65 per cent. On the other hand, he believed that the reliability coefficient for steam vehicles, taken by Mr. Broekman at 85 per cent., would be much below this in practice, and he cited a case where a user with seven steamers only obtained 1,099 days of service in the year, an average of 157 days each. He agreed that for heavy tonnage and straight-away runs of some distance steam lorries, especially when equipped with trailers, were a factor in transportation economics. When the steam lorry was equipped with rubber tires, up to five tons the electric vehicle was competitive, and held certain advantages, but larger steamers without rubber tires and with trailers operated at a lower cost per ton-mile than any other form of land transport. The figures showing the mean current consumption of a number of vehicles of different sizes in New York was most interesting. In New York street surfaces were generally very good, with only a few slight gradients, yet the current consumption of the fleet belonging to the Glasgow Corporation electricity department compared favourably. Most prospective users were obsessed with the idea that a high maximum speed was a desideratum; he instanced a case where a certain delivery round, usually covered by a Ford runabout in 55 minutes, was undertaken by a 30-cwt. electric bread-van and covered inside of 65 minutes, though the maximum speed of the former was three times that of the latter. This result was, of course, due to the superior acceleration of the electric vehicle after stops. To charge interest on the total outlay during the whole life of the vehicle, regardless of the proportion written off annually as depreciation, was against accepted procedure, and was merely unduly favouring whatever vehicle was lower in first cost. This effect might be seen in the tables where the charges for interest were nearly twice what they should be, thus unduly favouring the cheaper lead battery. The L.G.B. had recommended public authorities who owned electric vehicles to depreciate them at 10 per cent. He believed that 15 per cent. all round might have been taken for petrol vehicles. At low mileages there would be more frequent stops, with running of engines idle, and additional starting strains. Again, 10 or 12 per cent. for steam vehicles was not enough; the steam vehicle was more at the mercy of the attendant, who by a few minutes' inattention could very seriously shorten its life. He could not say how many vehicles with lead-acid batteries had since gone into service, but he could say that over 650 road wagons, delivery vans, and industrial trucks had been equipped with the nickel-alkaline battery. Of these over 250 were trucks, locomotives, and tractors, and the remainder road vehicles. There were now actually in use in Glasgow 14 road wagons, and several more were on order.

Mr. G. L. Black remarked that during the past 12 months not a single day had been lost owing to electrical defects by any of the four vehicles owned by the Glasgow Corporation electricity department. These vehicles comprised two vans, one of half-a-ton, and the other of one-ton capacity; and two lorries, one of three tons and the other of half that capacity. During 12 months they ran 5,015, 7,666, 4,278, and 6,648 miles respectively, the electrical energy put into the batteries being 0.59, 0.6, 1.3, and 1.1 kw.-hour per mile run. The latest addition was a five-ton tipping wagon for the removal of ashes. It worked on a rather difficult route, part consisting of a gradient of 1 in 21, and required a battery input of 2.6 kw.-hour per mile run. In time of snow it was found that the electrical energy required was about 60 per cent. above the normal. A pleasing feature about these vehicles was the very small amount of attention the motors required, and consequent low cost of repairs.

Mr. F. W. Purse remarked that the Carlisle Corporation was proposing to acquire an electric as soon as possible.

HIGH-SPEED TELEGRAPHY.

(*Concluded from page* 119).

Having reviewed the automatic high-speed systems, the Committee makes the important announcement that for ordinary commercial telegraph work between the main centres of the British Post Office service the inventions based on the multiplex method are superior. Multiplex systems conduce to economy in staff and in office equipment, they are subject to less serious stoppages and delays than automatic systems, and necessitate less spare plant and less costly maintenance, and they are economical in respect of lines and of paper tape for transmission.

The fundamental principles of nearly all multiplex instruments are based on the Baudot system, invented over 30 years ago. The production of this system may be regarded as marking an epoch in the history of telegraphy. The leading features of the Baudot system are (1) its method of obtaining synchronism, (2) its direct transmission from keyboard to line, (3) its cadence and speed, (4) its direct printing on slip.

(1) "Synchronism" is a feature of all multiplex systems, essential to the maintenance of correspondence in speed between the distributors placed at the sending and receiving ends of the line. The Baudot maintains synchronism by means of a centrifugal friction governor, a mechanical correcting device, and a special correcting signal. In the Western Electric multiplex this special signal is dispensed with, and the message signals are utilised for correction of phase. The relative merits of these approved methods of correction are still undecided.

(2) and (3) In the Baudot as usually worked, the sending operators depress combinations of five keys (similar to the white keys of a piano) according to the five-unit Baudot alphabet and transmit the signals direct to line. Each arm of the Baudot is worked regularly at a uniform speed of 30 words a minute, and each operator knows by observing the "cadence" or rhythm of the system when the distributor gives him the use of line wire.

(4) The Baudot prints in type letters on a receiving tape, which has to be gummed on telegraph forms. In this respect it differs from other systems which print direct on the forms themselves.

The Baudot has been in use for a considerable time on an underground loop between London and Birmingham, where it has been worked on the duplex principle with quadruple, and latterly with sextuple, that is to say, with four arms in each direction, and latterly six arms in each direction. There is quadruple duplex Baudot working (two circuits) on underground wires between London and Glasgow, and quintuple duplex working between London and Liverpool. Baudot has also been installed between London and Brighton. Experience has definitely proved that at least eight channels with 30 words a channel can be provided on a loop or on a single aerial line. As all multiplex systems are now worked duplex, it is of interest to record that this was first accomplished with the Baudot apparatus in 1906 on a method devised by Mr. A. C. Booth, of the engineering staff of the Post Office.

The speed for which the Baudot apparatus has been designed and constructed, viz., 30 words per minute for each operator, could be increased without a radical modification of the system, but experience has shown that a much greater increase of speed can be obtained by the use of type keyboards and perforated slip instead of hand operation, and it is suggested that one or more of the modern forms of keyboard should be applied to the Baudot.

Mr. Donald Murray's multiplex system has been in use on a London-Manchester wire for four years, working double duplex. It has given good results, and in some respects, notably in the design and working of the keyboard perforator, it is admirable. But its electrical method of controlling synchronism is not so satisfactory as the methods adopted with other multiplex systems. Although the use of the keyboard admits of a speed of 40 words per arm per minute, the limitation of the present equipment to double duplex does not afford a complete basis for comparison. This will not apply to Mr. Murray's new multiplex, which, however, is not yet available, as its manufacture has been unfortunately delayed by war conditions.

The Western Electric multiplex apparatus is the most generally satisfactory system for busy lines which we have examined. A quadruple duplex installation of the system has been working since March last between London and Manchester. The average number of telegrams per operator per hour is consistently well over 40, and has reached 49. The apparatus has dealt with about two-thirds of the whole traffic between London and Manchester on a single circuit. There are not many circuits in the kingdom capable of keeping the apparatus fully fed; but we think that the question of extending the use of the system should be proceeded with without delay, and that the further question of giving greater scope for its use by the making up of "forked" circuits linking up several towns should be pursued as soon as possible. The Western Electric apparatus embodies all those principles which are regarded as desirable; it works with a free keyboard perforator and cross-perforated sending tape, it employs the five-unit code, and it prints direct on the "page." It also adopts a method of controlling the synchronism by the use of the actual message signals, which has proved to be efficient. In view of the Post Office experience with the quadruple duplex installation, we also consider that an early trial should be given to the "short line printer" and the "two-way service" installations of the Western Union. It seems likely that both, representing as they do printing telegraphy on the scale of the ordinary simplex or duplex Morse circuit, would go some way towards restricting the use of the Morse at the smaller telegraph offices.

It has been stated in evidence that certain devices in the Western Electric multiplex infringe Mr. Donald Murray's patent rights in this country. This is a question of law on which the Committee cannot express an opinion. Contracts for the supply of telegraph apparatus always contain a clause under which the Postmaster-General is freed from all liabilities which might otherwise attach to him under decisions as to the patent rights of inventors.

The Automatic Telephone Manufacturing Co.'s system, as described to us, appeared to possess striking and original features. If the apparatus fulfils the inventor's hopes it should be of use in the Post Office service.

As Wheatstone working will probably be long retained for news and for traffic caused by abnormal events, we do not anticipate that existing Wheatstone plant will be allowed to fall into disuse to any serious extent. There is sufficient diversity in the traffic requirements of the various telegraph circuits and routes of the Post Office service to admit of the profitable use of all existing apparatus until worn out.

The prospect of an extension of multiplex methods makes it necessary again to consider the position of the leading operator, called in France the "dirigeur." The "dirigeur" is virtually the supervising officer of a multiplex circuit, and he has to be a man of good technical capacity, able to apply his technical knowledge, and to act promptly. The Committee does not think that the performance of this work can be expected from the general body of sorting clerks and telegraphists, or that the scale of pay of sorting clerks and telegraphists provides adequate remuneration for the duties. When once the simplicity of the Morse system is abandoned in favour of more rapid and more economical apparatus, which is necessarily more complex, provision must be made for the employment of a limited number of officers with higher technical attainments and higher pay than ordinary telegraphists.

In the event of any general extension of multiplex methods, it will be necessary to consider how far such systems are applicable to existing methods of news distribution. There is no doubt that if Wheatstone methods for news could be gradually superseded by multiplex, so as to avoid unnecessary duplication of plant, a great advantage would be gained. But the extent to which the outgoing Press work of the kingdom centres in London, and goes outwards to the provinces, the high speed of the ordinary Wheatstone circuits, and the fact that the forked wires of the present arrangement serve a larger number of towns than multiplex systems have yet been proved capable of serving simultaneously and satisfactorily, are considerations which suggest the possibility of great difficulties in the way of such a process. There is no doubt that the news service at present provided is good.

Creed receiving apparatus is well suited to the needs of a large newspaper office, which under ordinary Morse methods has to pay high bonuses to the staff lent to it by the Post Office in order to procure a large output; as there is no apparatus other than the Creed which converts the Wheatstone receiving tape into type printed characters, the newspapers have no third possibility to consider. News does not reach small towns quite as soon as it reaches large ones, but the installation of Creed receiving apparatus at small offices would be impracticable on the ground of expense.

The following is a summary of the leading conclusions of the Committee:—

1. Systems on the multiplex principle are definitely superior to the automatic high-speed systems on the large majority of main circuits for ordinary inland commercial telegraph work.

2. The extension of systematic Wheatstone working should be discontinued, and the question of displacing it by multiplex circuits taken up gradually.

3. Of the multiplex systems at present available, the Western Electric has given the best results. We recommend that a number of quadruple duplex installations of this apparatus be ordered. We think that seven or eight such sets should suffice, as, although present conditions favour the rapid application of systems with the greatest output, it is desirable to avoid too great a dislocation of working, and to allow time as far as possible for other makers to demonstrate their capabilities.

4. Page or column-printing is preferable to tape-printing on the busiest routes, and the Western Electric Co.'s page-printing on a continuous roll of paper, cut off after each message, is quite satisfactory. Mr. Murray's system, with a separate sheet for each message, has been given a trial on his Manchester multiplex, but a fuller trial of his improved method will be necessary. We do not think it desirable that either page or column printing should be adopted throughout the service to the exclusion of tape-printing.

5. The five-unit alphabet as a code for printing telegraphy is better than the Morse code, news traffic and submarine cable communications being left out of account.

6. The application of type keyboard signalling instruments to the present Baudot circuits is desirable.

7. Creed receiving apparatus can most profitably be used in the Post Office service for news work.

8. The application of printing methods to the less important circuits should be kept steadily in view, and early trials of the one-way and two-way installations of the Western Electric and of the light line printer of the Automatic Telephone Manufacturing Co. should be made. We are impressed with the possibility of two-way working with one operator at each end, both to signal their messages simultaneously to the other end and then both to gum the tape. An hourly load can be carried in this way equivalent to the average Morse load with two operators at each end, and having the additional advantage of printing the telegrams.

9. The introduction of multiplex methods for news work will call for serious consideration in the near future.

10. The application of multiplex systems to give simultaneous communication on one wire between each one of three, or possibly more, offices should be kept in view as multiplex methods are extended.

11. The pay and prospects of officers selected to be "leading operators" of multiplex circuits should be reconsidered.

The Committee consisted of Mr. Cecil Norton (Chairman), Sir J. Gavey, Mr. John Lee, Mr. W. M. Mordey, Mr. A. M. Ogilvie, Sir W. Slingo, and Mr. A. B. Walkley, with Mr. G. O. Wood (Secretary).

Electric Smelting at Heroult.—The Noble Electric Steel Co., San Francisco, has operated its electric smelting plant at Heroult, California, continuously since April 15th, 1916, turning out a ferromanganese product. The furnace now in use is described as the Frickey open delta, split-phase arrangement of electrodes. The ore smelted varies, but much of it runs 46 to 48 per cent. metallic manganese, 14 to 16 per cent. silica, and 2 to 3 per cent. iron. The furnace product contains 80·5 to 81·5 per cent. manganese. The plant capacity is 9 tons per day, but this is to be increased. This company in 1915 began developing and mining chromite ore; part of the ore is smelted at the Heroult plant by methods practically similar to those employed in ferromanganese smelting. The furnace product is a ferrochromium containing 60 per cent. chrome oxide and 30 to 32 per cent. iron oxide.—*Mining and Engineering World.*

THE WORK OF THE B.E.A.M.A.

[The Annual Report.]

(*Concluded from page* 140.)

The Association is represented on the British National Committee of the International Electrotechnical Commission, and on the Sectional Electrical Committee, and a number of sub-committees and panels of the Engineering Standards Committee; also on the Committees of the I.E.E. dealing with wiring rules and with marine (other than Admiralty) work, and on the Electric Vehicle Committee. The B.E.A.M.A. Standardisation Committee continues its co-operation with the Engineering Standards Committee in the preparation and revision of the new British Standardisation Rules, and has prepared detailed recommendations for the revision of the Engineering Standards Committee's report No. 72. Other work of the Association Committee (assisted by representatives of the interested Sections of the Association) includes the following subjects:—

Motor Starters, under which a specification has been prepared to serve as the basis for the E.S.C. rules now in preparation.

Transformers for Meters and Instruments, under which a specification has been prepared for incorporation in the revised E.S.C. specifications for meters and instruments.

Graphical Symbols, under which the recommendations made have been very fully adopted in the new E.S.C. draft rules.

Switchgear Symbols, under which the section of the Association's rules dealing with this subject has been revised and considerably enlarged.

Marine Generating Sets, under which a Joint Committee has been established to deal with the standardisation of electric generating sets for marine purposes.

Ammeters and Voltmeters, being a revision of E.S.C. Report 49, which is now well in progress (the recommendations from this Association receiving full consideration) in the revised draft of which the proposed specification for transformers for use with these instruments is being embodied.

Electricity Meters (E.S.C. 37), under which recommendations have been made to the E.S.C. covering a proposed revision of this specification.

Accessories, under which recommendations are being prepared for the assistance of the E.S.C. in the standardisation of lamp-sockets and other details.

I.E.E. Wiring Rules, under which recommendations have been transmitted to the Institution regarding desirable amendments in the present (7th) edition of the Wiring Rules.

The Council adopted Engineering Standards' Committee's Specification No. 74, being a specification of a standard electric vehicle charging plug, prepared by the Electric Vehicle Committee.

On February 1st, 1916, the Council issued "Instructions to Members for the use of Conditions of Sale and Contract," amending and consolidating all previous instructions on this subject. Little opposition to the Association's conditions has been encountered during the year, thus bearing added testimony to their reasonableness. Fifty-six different purchasers raised questions which were amicably settled with the assistance of the industrial solicitor. Of these, 46 came from municipal and 10 from industrial purchasers. Many were merely repetitions of a question previously settled with the same purchaser. The work involved included 150 personal interviews with, and about 400 written communications by, the industrial solicitor.

The Council successfully protested against circular instructions issued by the Mines Department to their Inspectors, stating that where British firms had difficulty (owing to "control") in supplying machinery, such machinery could be obtained from America.

The Council appointed witnesses to prepare a case for submission to the Commissioners of Inland Revenue in favour of increasing the standard percentage of profits allowed under the Finance Act (No. 2), 1915. The case prepared was referred to the Board of Referees, before whom the witnesses made several appearances. It was proved to the satisfaction of the Referees that the electrical industry had become a national "key" industry, and that it was essential that it should receive adequate consideration at the hands of the Government. As a result of the Council's efforts, the standard percentage was raised by 1 per cent., as already announced in the Electrical Review.

During the year the Council, at the request of the Accumulator Section, was successful in obtaining from the Local Government Board extensions of the loan periods for storage batteries from seven to ten years, and five to seven years in certain cases respectively. The same Section was similarly successful in obtaining a desired revision of the battery specification issued by the War Office.

The Supply of Electricity Bill promoted by the I.M.E.A. was scarcely expected to make progress in present circumstances, but it is understood that a further effort will be made to advance it this year.

The Incorporated Association of Electric Power Companies has invited the co-operation of the Association in drafting a new Electric Lighting Bill.

The Council invited members to make towards the equipment of the Peking University's laboratories gifts of machinery similar to those presented to the University of Hong-Kong. A report on the subject will be issued to members.

The growth and progress during the year of various bodies formed to foster British and Empire industry had been noted with much interest and sympathy. One such body, the British Empire Producers' Organisation, whose efforts extend into many oversea dominions, had already received the Council's support. Another, the Federation of British Industries, formed primarily to watch over the industrial interests of this country, has the Council's cordial sympathy. The chairman of the B.E.A.M.A. has been on its executive council since its formation, and several members of the Association have joined it.

The growth of the B.E.A.M.A. has rendered advisable the creation of some co-ordinating body composed of members closely connected with the work of the Sections, and the Council welcomes the proposed establishment of a Sectional Committee or Board composed of such members and reporting to the Council. It is hoped by this means to concentrate effort in matters common to all Sections.

The system of tendering embodied in the agreements known as cross-tendering agreements continues to find favour among members, but has not been extended during the year. The Association has in operation the following such agreements: (1) Steam-engine builders and dynamo makers, (2) Diesel-engine builders and dynamo makers, (3) steam-engine builders, (4) turbine makers, (5) condenser makers.

Several arbitrations were submitted and settled during the year. The steady growth of the Association obliged the Council early in the year 1916 to take into question the advisability of moving into larger premises. They finally decided that during the period of the war they should manage with the present holding by carrying out some alterations. These were completed in June. The work of the Association's status inquiry agents, the British Traders' Association, has proved useful and satisfactory to members.

The number of members on the register at the end of the year (December 31st) was 144. Thirty firms were admitted to membership during the year, and one resigned.

CO-OPERATIVE EXPORT TRADE.

In our last issue we announced the registration of a new company with the title "British Switchgear, Ltd.," and as it represents an enterprise of exceptional interest, we are glad to be in a position to give further particulars as to its constitution and purposes.

In the Electrical Review for December 31st, 1915, we welcomed the registration of the Electrical Manufacturers' Co. of Great Britain, Ltd., which was formed by seven well-known electrical manufacturing concerns to act co-operatively in the Russian market. An eighth has since been added, making three dynamo and motor, and five switchgear companies, as follows:—

Bruce Peebles & Co., Ltd.
Crompton & Co., Ltd.
Lancashire Dynamo & Motor Co., Ltd.
Allen, West & Co., Ltd.
Brook, Hirst & Co., Ltd.
Erskine, Heap & Co., Ltd.
Whipp & Bourne, Ltd.
Electric Control, Ltd. (since added).

The nominal capital of the Manufacturers' Association was £12,000 in £1 shares, and we are pleased to learn that very satisfactory progress has been made with the business considering, of course, the shipping and other difficulties of the times.

British Switchgear, Ltd., which has now been formed with a capital of £48,000, is closely related to the Manufacturers' Co., indeed, their offices are together in that magnificent building, Australia House, Strand, W.C., which, when it is finished, will be one of the most palatial piles in London. What offices could have been taken more appropriately for the housing of so promising and important an electrical enterprise? Mr. H. C. Siddeley, in whose mind the germ of the co-operative organisation first had birth several years ago when touring Colonial and foreign markets, was chairman

ELECTRICAL MANUFACTURERS Co.
OF
GREAT BRITAIN LIMITED.
LONDON MANAGERS.
BRITISH SWITCHGEAR Ltd
REGISTERED OFFICE.

BRITISH SWITCHGEAR LIMITED.
BROOK, HIRST & Gl^td. — CHESTER.
ELECTRIC CONTROL L^td. — GLASGOW.
ERSKINE HEAP & Co L^td. — MANCHESTER.
MANAGING DIRECTOR
H. C. SIDDELEY.
REGISTERED OFFICE.

of the Manufacturers' Co.—known in brief as "The Russian Syndicate," but he has now been followed by Mr. E. H. F. Reeves in that capacity, and Mr. Siddeley will be its manager and secretary, while, at the same time, he will hold office as

managing director of British Switchgear, Ltd., who are the managers for the Electrical Manufacturers' Co. of Great Britain, Ltd. Mr. A. P. Wood, the well-known and far-seeing manager of the Lancashire Dynamo & Motor Co., Ltd., has been elected a new director of the Russian Syndicate now that Mr. Siddeley has resigned that particular office. In the reproductions of nameplates on the previous page we show at a glance the relation of the two concerns and their respective monograms :—

The Manufacturers' Co. has offices at 13, Myasnitskaya, Moscow, in charge of a well-known Russian electrical engineer, Mr. S. I. Landau, who, for the best of reasons, has had a very wide experience in Russia, and has the right knowledge to enable him to deal satisfactorily with the Government and with other authorities. In London, too, the personnel is strengthened by the presence of a Russian engineer, who received his training in Belgium. We have been privileged to see documents showing that The Manufacturers' Association is acknowledged by the authorities in Russia as working for the Russian national defence.

British Switchgear, Ltd., operating at Australia House will in the first instance deal with the Russian switchgear contracts of the "Syndicate," but it will also represent three members in London and trade in their manufactures in other parts of the world, opening foreign branches and establishing foreign agencies for British switchgear on behalf of the three firms whose names appear on the nameplate above.

The advantages of co-operative action among different firms, whether makers of like or unlike manufactures, are too well known to readers of the Electrical Review to need detailed re-statement here. In this particular case, however, the arrangement of the two organisations along the above lines will not only make for economy, efficiency, and strength, as the result of concentrated effort in an expert selling company employing a better-paid staff than individual firms are generally able to engage, and having one strong series of operations instead of separate and rival action by an agent appointed by each firm, but the three firms interested in British Switchgear, Ltd., will be able to offer a complete line of switchgear, and the prejudice against the splitting up of orders need not exist in the mind of the purchaser. The combined output of the three firms is very large, and they will thus be in an excellent position to put up a strong competition against the efforts of very large German and American concerns. A point claimed in favour of the grouping of similar firms, and one which should not be lost sight of, is the personal factor. Each of the firms has a live, enterprising specialist in its own particular department of manufacturing, and when a number of such specialists meet round a board table, armed with authority to take action according to the requirements of the moment, prompt measures and the best results may be expected to follow.

Co-operation between groups is a policy pursued entirely on their own initiative by firms in the ranks of the B.E.A.M.A.—indeed, all of the eight firms in the Siddeley Russian groups are active members of that Association.

The new organisations have our best wishes for their success in trying to win for British electrical industry a large share of the coming trade with the vast Russian market. The foundations of the business are being well laid by men of wide experience and sound judgment, and their far-seeing plans have been prepared at the right moment to enable them to take full advantage of the situation. We have no doubt that their doings will be watched with great interest by the industry as a whole, and that their example will, in course of time, be followed by manufacturers of other electrical lines.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

[*Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest to our readers.*—Eds. Elec. Rev.]

B.T.H. Crane Motors.

A recently-issued List, No. 2,269, describes the crane and hoist motors manufactured by the British Thomson-Houston Co., Ltd., of Rugby. These motors are standardised for various ratings up to 50 h.p. for 115-230-550-volt circuits.

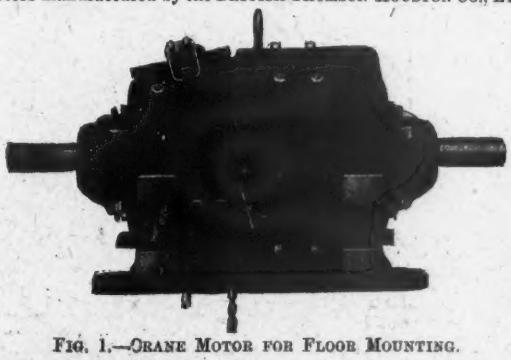


Fig. 1.—Crane Motor for Floor Mounting.

The machines are totally enclosed, reversible, four-pole series wound, and fitted with commutating poles.

The magnet frames are of cast steel, divided horizontally, and octagonal in shape; the top half carries the brush-holder studs. The end shields carrying the bearings have oil reservoirs, and can

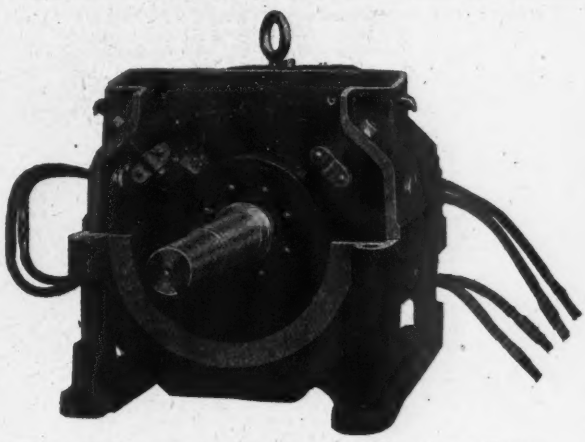


Fig. 2.—Motor with Frame cut away to show Brush Gear, &c.

be swung 90° or 180° to keep the oil supply below the bearings when the motor is mounted on wall or ceiling.

The field and armature coils are former wound. The armature core and commutator are assembled on a sleeve, which construction permits the removal and insertion of a shaft without the necessity of disturbing the armature windings or the commutator. Similar extensions are provided at each end of the shaft, so that the spur gear or the brake can be mounted at either end.

The machines can be fitted with back gears on either side of the frame; series-wound magnetic brakes can be mounted; disk brakes to hold half the full-load torque of the motors; or shoe brakes to hold the full-load torque, the braking power being adjustable.

B.T.H. Pressure Governors.

The British Thomson-Houston Co., Ltd., of Rugby, in a recent list (No. 5,521), described its type CR 2,920 pressure governor panels for A.C. or D.C. circuits. These are designed for use with automatic starters controlling motor-driven pumps or air compressors for maintaining a constant pressure of air or water. A panel of this type is illustrated in fig. 3, and consists of a Bourdon tube

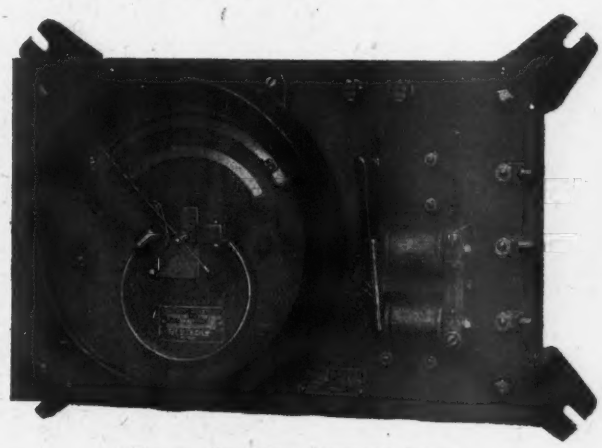


Fig. 3.—Pressure Governor Panel.

gauge operating a pointer fitted with silver contacts, which serve to make a small-current circuit for operating the relay mounted on the right of the panel; this relay will operate on either A.C. or D.C. circuits, and, when energised, closes or opens the operating circuit of the automatic starter. No circuit is actually broken on the gauge contacts, and as the relay coils are only energised momentarily, no series resistance is necessary for them.

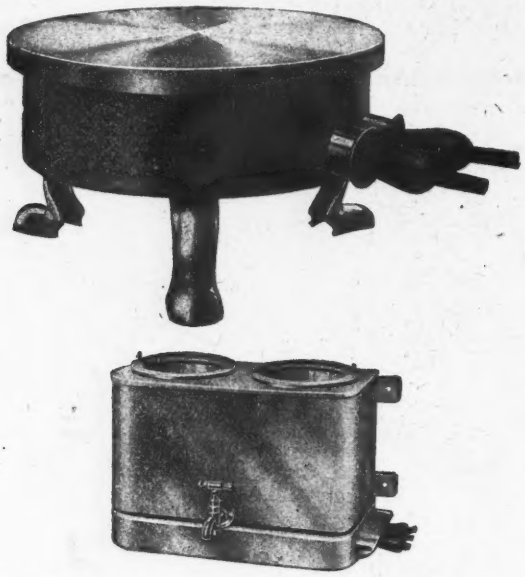
The panels are made for pressures up to 1,500 lb. per sq. in.

Simplex Heating Apparatus.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have just issued a new catalogue (No. 647) of electric heating and cooking apparatus, which shows a good range of their "Plexsim" goods.

Many of the articles illustrated are specially designed for industrial use, and we understand there has been a particularly brisk demand from many of the national and other factories recently built, which tends to show that electric heating is taking its share in the "factory efficiency" campaign now in progress.

Among the articles illustrated are large electric kettles and urns for mess rooms, staff tea rooms, &c., also industrial hot plates, glue, wax, and solder pots, and stills for distilled water in various sizes.



Figs. 4 and 5.—Plexsim Hot-plate and Glue-pot.

Fig. 4 shows a hot plate, made in 7-in. and 8-in. diameter sizes, with loadings of 750 and 1,000 watts respectively, while fig. 5 is a copper glue pot, each pot holding 2½ pints, fitted with an 850-watt heater.

The Plexsim electric still, made in two sizes, for 4 pints and 4 gallons, is designed for workshop use and built in sections, all parts being accessible.

Wattmeter Correcting for Transformation Losses.

A singular type of wattmeter, that enables one to measure the high-tension input from the low-tension output side, is the work of an Austro-Hungarian inventor, Gino Campos, of Milan, Italy. Ordinarily wattmeters are designed to indicate the input or output *in situ* by connecting the voltage and current coils to determine the watt factors at the point of measurement. However, by the disclosure made in Patent No. 1,201,996, it becomes possible to measure the total input on the high-tension side of a transformer by merely connecting the wattmeter to the low-tension side of a transformer. In other words, the wattmeter automatically corrects for the transformer losses. This ingenious result is accomplished by simply

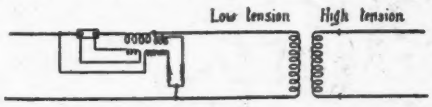


Fig. 6.—Diagram of Circuit Connections.

compensating the voltage and current coils of the dynamometer by means of additional turns, whose fields are proportional to the current and voltage respectively of the low-tension side. Because the copper losses of transformation are proportional to the square of the current, and the iron losses are substantially proportional to the square of the voltage, it is seen that such compensated winding can suitably add to the deflection reading of the wattmeter, to make it measure both the low-tension output and the watts lost in the transformation of power.—*Electrical World.*

The Heat Treatment of Steel.

In the heat treatment of steel it is all-important to know exactly when the critical temperature is reached. In the "Crit-point," a new instrument of the Gibb Instrument Co., of Pittsburg, Pa., use is made of the well-known fact that steel in the process of heating loses its magnetic properties when it is brought to its critical point. Through the medium of electromagnetic coils the magnetic condition of the steel in the furnace is determined. A magnetic indicator is placed in the circuit, so that this meter immediately indicates whether the steel has reached its critical point. When the temperature of the surface comes to the critical point, the meter needle approaches a red line indicative of the critical point, and gradually comes closer to it as the heat penetrates the steel and the interior is brought to the critical point.

It will be seen that the "Crit-point" does not measure temperature. But the exact knowledge of the temperature is irrelevant, so long as the heat-treating man has a simple and exact means for ascertaining when the critical temperature is reached.—*Met. and Chem. Engineering.*

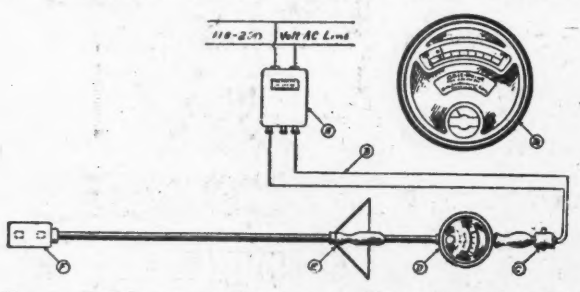


Fig. 7.—The Crit-point Detector.—A, Small Transformer, 110 or 220 v.; B, Flexible Lampcord; C, Switch; D, Indicator; D_1, Indicator Enlarged; E, Asbestos-protected Shield; F, Search Coil.

NEW PATENTS APPLIED FOR, 1917.
(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

1,046. "Accumulators for miners' electric safety lamps." J. Taylor. January 22nd.

1,050. "Receivers for telegraphy, telephones, &c." T. Harvey. January 22nd.

1,060. "Multiple crystal detector for wireless telegraph instruments." J. Hetherington. January 22nd.

1,062. "Electric switching apparatus." W. J. Howard & A. Reyrolle and Co. January 22nd.

1,071. "Antennæ for wireless signalling." British General Electric Co. and General Electric Co. January 22nd.

1,080. "Electric terminals or connections." H. C. Bell. January 22nd.

1,095. "Automatic electric control of petrol, electric, &c., vehicles." V. S. Robinson & P. F. Smith. January 22nd.

1,101. "Automatic stopping device for steam or electric locomotives and railway rolling stock." J. B. S. Poyser. January 23rd.

1,110. "Electrical apparatus." N. Stell. January 23rd.

1,113. "Method for guiding electric wire into groove of trolley wheels of tramcars, &c." T. Main. January 23rd.

1,114. "Electric switches." A. Crawford, W. Preston, & W. Sanders and Co. January 23rd.

1,122. "Means for travelling electric contacts." R. Donald. January 23rd.

1,146. "Electric furnaces." G. B. Filmer & J. J. Denton. January 23rd.

1,155. "Motor vehicle lighting dynamos." C. L. Breeden & H. Lucas. January 23rd.

1,177. "Electrical fire alarms, &c." R. Cawthorne. January 24th.

1,184. "Apparatus for operating feed devices of reciprocating tools, &c." Lancashire Dynamo & Motor Co. January 24th.

1,223. "Process for electrolytic treatment of metals, ores, their residues, &c." F. Bourgeot. January 24th.

1,233. "Electric signalling system." R. Lambourne. January 24th.

1,256. "Sparking plugs." V. Perrett. January 25th.

1,277. "Process for manufacture of thermo elements having copper sulphide as the positive constituent." J. Marschall. January 25th. (Germany, December 9th, 1915.)

1,278. "Dynamo-electric machines." British Thomson-Houston Co. and J. Martin. January 25th.

1,279. "Automatic switching devices for thermic telephones." B. E. D. Kilburn (Naamlooze Vennootschap de Nederlandsche Thermo Telephoon Maatschappij). January 25th.

1,282. "Winding for electric coils." M. Martinez. January 25th.

1,303. "Ignition devices for internal-combustion engines." P. T. Woodland. January 25th.

1,307. "Apparatus for producing perforated strip by electrical current impulses." Creed & Co. and H. H. Harrison. January 25th.

1,310. "Manufacture of tungsten oxides, salts, and/or metal from tungsten ores, minerals, intermediate products, residues, and/or wastes." E. A. Ashcroft. January 26th.

1,315. "Electric ovens, &c." F. P. Fletcher. January 26th.

1,343. "Self-generating electric pocket lamp." F. D. M. Gordon. January 26th.

1,346. "Small electric motors." E. Volkers. January 26th. (Germany, February 17th, 1916.)

1,347. "Automatic telephone systems." Automatic Telephone Manufacturing Co. January 26th. (U.S.A., February 14th, 1916.)

1,355. "Electrical batteries." W. A. Saxby. January 26th.

1,390. "Terminal connections for accumulators or secondary batteries." W. O. Kennington. January 27th.

PUBLISHED SPECIFICATIONS.

1915.

17,319. Electric Heaters. C. R. Belling. December 9th.

18,103. Filament Winding Machines. Westinghouse Metal Filament Lamp Co. December 28th. (U.S.A., December 29th, 1914.)

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

70. Electric Controller, particularly for use in connection with Electrically-propelled Vehicles. J. E. Hamilton. January 3rd, 1916. [102,981.]

135. Driving Clutches for the Magnetos of Motor Cars. A. Saurer (firm of). January 5th, 1915. [100,005.]

241. Power Transmission on Rail and Road Trains and the like. J. G. P. Thomas & Thomas Transmission, Ltd. January 6th, 1916. [102,987.] (Cognate application, 1,229/16.)

334. Order Telegraph and Light Instruments. L. Schor. January 7th, 1916. [102,993.]

455. Apparatus for the External Shaping of Clay in the manufacture of Telegraph Insulators and the like. H. L. Doulton & W. Podmore. January 11th, 1916. [102,994.] (Addition to 22,757/14.)